

# SIZE OF INDIVIDUAL CONTACTS IN SLIDING FRICTION

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SLIDING FRICTION

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## ABSTRACT

### THE SIZE OF INDIVIDUAL CONTACTS IN SLIDING FRICTION

by

John Allan Seward, Jr.

Robert Blake Hayman

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The object of this investigation was to determine the size of individual contacts in sliding friction by electronically measuring the duration of individual contacts. To accomplish this, a fine insulated tungsten wire and three heavier tungsten wires were imbedded in a glass probe which was ground so that the ends of the tungsten wires were exposed and formed a plane. A plane surface of 1045 steel was rotated beneath, and supported the probe which was held stationary by a pivoted rider arm. The duration of contacts between the fine insulated tungsten wire and the 1045 steel plate was measured electronically by a Sanborn recorder.

Calculations showed that the diameter of the average contact area occurring in sliding friction has an order of magnitude between  $2 \times 10^{-4}$  cm and  $6 \times 10^{-4}$  cm. Most of the contact areas have diameters much smaller than the diameter of the average contact area. The size distribution of the contact areas is such that the log of the number of contacts bears a linear relationship to the log of the average area for intervals of equal area.

Further investigation is required to determine the effect of contact deformation, relative velocity, surface finish and loading on the size of individual contacts in sliding friction.

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## TABLE OF CONTENTS

	Page
I. INTRODUCTION .....	1
II. PROCEDURE .....	5
III. RESULTS .....	10
IV. DISCUSSION OF RESULTS .....	12
V. CONCLUSIONS .....	18
VI. RECOMMENDATIONS .....	19
VII. APPENDIX .....	20
A. Pictures of Experimental Set Up and Sketch of Probe .....	1
B. Representative Tape .....	6
C. Graphs of results .....	8
D. Identification of Tapes and Tabulated Data .....	12
E. Tabulated Distribution of Contact Areas .....	53
F. Sample Calculations .....	56
G. Bibliography .....	59

# TABLE OF CONTENTS

Page

I	INTRODUCTION	i
II	REVIEW OF LITERATURE	ii
III	MATERIALS AND METHODS	iii
IV	RESULTS AND DISCUSSION	iv
V	CONCLUSIONS	v
VI	ACKNOWLEDGMENTS	vi
VII	REFERENCES	vii

## A. LIST OF TABLES

I	TABLE OF CONTENTS	i
II	REVIEW OF LITERATURE	ii
III	MATERIALS AND METHODS	iii

## B. LIST OF FIGURES

I	FIGURE 1	i
---	----------	---

## C. LIST OF APPENDICES

I	APPENDIX A	i
II	APPENDIX B	ii
III	APPENDIX C	iii



## I. INTRODUCTION

Traditionally, the most satisfactory method for treating the subject of friction has been by the use of experimentally determined coefficients.

In expressions like the following one for total shear force

$$F_s = \tau A$$

neither  $\tau$  nor  $A$  is known with precision.  $\tau$  in fact, may vary considerably from one individual metallic contact to another. Thus  $A$  is really nothing more than a fictitious apparent area which may or may not be the same as the true area of contact. In handling most practical situations, it is not necessary to know these quantities exactly. However, if the mechanism of friction is to be more completely explained, it seems reasonable to suppose that a great deal more information concerning the size and distribution of the individual metallic contacts must be obtained.

Several methods for investigating the true area of contact between metallic surfaces have been devised.

Holz<sup>(1)</sup> estimated the true contact area by the measurement of electrical resistance. There are some rather severe restrictions which limit the validity of this approach, the unpredictable constriction effect upon the accuracy of the resistance measurements as a true in-

# 1. INTRODUCTION

Traditionally, the most satisfactory method for  
 finding the subject of interest has been by the use of  
 systematically obtained coefficients.  
 In experiments like the following one for example  
 eight force  

$$T = T_0 + \dots$$
 where  $T$  is a known with pressure.  $T$  is left, and  
 very considerably from the individual particle system  
 is constant. Thus a possible relation may be  
 found between the relation as may not be the same.  
 is the true value of constant. In addition most practical  
 situations, it is not necessary to have very complicated  
 theory. However, if the mechanism of reaction is to be  
 more completely understood, it is necessary to know  
 that a great deal more information concerning the  
 and situation of the localities where objects may  
 be obtained.  
 Several methods for investigating the form of  
 relation between the variables have been devised,  
 which are estimated and are constant with the  
 necessity of statistical treatment. There are many  
 other ways of determining which is the result of  
 this approach, the mathematical considerations of the  
 the accuracy of the statistical treatment as a test for



dication of the area in contact and the effect of oxide film to name but two. At best this gives only a rough indication of the true over all contact area. It is impossible to interpret the results in terms of the individual contacts.

Dyson and Hirst<sup>(4)</sup> were able to draw several interesting conclusions from their work.

- a) Surface finish affects the distribution of the areas of contact.
- b) An increase in the loading increases the number of the groups of individual contacts but not their size. The size of the groups was estimated as about .2 mm for the pattern produced by pressing a silver steel plate against a silver coated piece of glass.
- c) Only a very small part of the metallic surface is in contact.

Here again, the method is not suitable for the determination of the individual contact areas. Also it gives a representation of the static picture only and the degree to which this can be taken as an indication of the dynamic picture is not known.

I-Ming Feng<sup>(8)</sup> has studied the surface characteristics of metals and reports the dimensions of the scratches produced by diamond dust (0 to .5 micron) to be of the order of .01 to .05 microns. One micron =  $10^{-4}$  cm.

direction of the area in contact and the effect of contact  
this to some extent. It does not seem likely that this  
indication of the time over all contact area. It is in-  
possible to interpret the results in terms of the in-  
dividual contact.

These two lines (1) were able to show several differ-  
ent conclusions from their work.  
a) contact lines affect the distribution of the  
contact area of contact.

b) An increase in the loading increases the number  
of points of the groups of individual contacts but not  
the size of the area. The size of the groups was well-  
defined and about 1.5 for the pattern produced  
by pressing a given steel plate against a steel  
plate. The contact area of plate.

c) Only a very small part of the available surface  
is in contact.

d) Again, the contact is not uniform for the  
distribution of the individual contact area. Also it  
shows a considerable of the elastic distance only and the  
degree to which there are no indication of the  
contact pressure is not known.

e) The lines (2) have shown the contact area  
of the steel and the steel. The distribution of the contact  
pressure is shown. The contact is not uniform for the  
distribution of the individual contact area. Also it  
shows a considerable of the elastic distance only and the  
degree to which there are no indication of the  
contact pressure is not known.

E. Rabinowicz has proposed three interesting though somewhat indirect methods for estimating the average diameter of the individual contacts.

1. As part of his investigation of the static and kinetic coefficients of friction, Rabinowicz<sup>(2)</sup> predicts an average contact diameter of about  $7 \times 10^{-4}$  cm for copper on steel.
2. Rabinowicz and Tabor<sup>(3)</sup> estimate the average weight of transfer particles produced by the sliding motion between metallic surfaces to be about  $10^{-5}$  grams. By assuming a simple hemispherical model, Rabinowicz<sup>(2)</sup> computed an average diameter of about  $17 \times 10^{-4}$  cm for the individual contacts.
3. The most recent method used by Rabinowicz<sup>(6)</sup> to predict the average diameter of the individual contact area comes as the result of the application of the auto-correlation analysis of sliding friction. The diameter obtained by this method is in the order of  $10^{-3}$  cm.

The work of this present investigation represents an attempt to determine the magnitude of the average contact diameter in a much more direct manner. The time that a very fine tungsten wire imbedded in glass (Fig. 4) remains in contact with the surface imperfections as it moves relative to the face of a steel plate may be re-





corded electronically by a Sanborn recorder. The problem which remains is essentially that of relating this measured contact duration to the individual area of contact.

considered simultaneously by a common factor. The results

which are obtained are essentially the same as those

obtained by the method of the individual case of con-

stant.

The results are given in Table I, and are compared

with the results obtained by the method of the individual

case of constant.

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case of constant.

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case of constant.

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with the results obtained by the method of the individual

## II. PROCEDURE

The apparatus used to determine the size of individual contact areas in sliding friction is shown in Figures 1, 2, and 3. Figure 1 is an overall view of the experimental set up. Figure 2 is a closer side view of the inverted drill press. Figure 3 is a close up showing in detail the mounting of the glass probe and steel plate.

A variable speed gear drive is used to turn the spindle of the inverted drill press. The flat plate specimen of 1045 steel is secured to a circular mounting block which is held in the drill chuck. The steel plate rotates beneath and supports the glass probe containing a fine tungsten contact wire. The glass probe is held stationary by a rider arm mounted on a platform which is clamped to the drill column. The rider arm is pivoted about a horizontal axis and balanced to permit the application of any desired total load. The steel plate is insulated from the mounting block and connected by wire to one side of a resistance bridge. The fine tungsten contact wire in the glass probe is connected to the other side of the bridge. The resistance bridge is connected to the Sanborn recorder so that contact between the steel plate and the tungsten contact wire can be recorded on tape.

The steel plate was rotated at speeds ranging



[illegible]



from .015 to .055 RPM. These low speeds were obtained by using a belt drive pulley system in conjunction with the variable speed gear drive. The lowest steady rotational speed which could be maintained by the variable speed gear drive with the pulley combination used was .015 RPM. The highest speed of rotation which still permitted distinguishing between the traces of individual contacts was about .055 RPM. Speed of rotation was measured by counting the circumferential distance which the rotating circular mounting block traveled with respect to a fixed pointer during one minute. Dividing this circumferential distance by the total circumference of the circular mounting block gave the speed of rotation in RPM.

A sketch of the glass probe is shown in Figure 4. The three relatively large diameter tungsten wires were undercut sufficiently to permit the fine tungsten contact wire to act as a high spot on that plane. Attaining the proper amount of undercutting to obtain intermittent contact between the tungsten contact wire and the steel plate was a trial process which took considerable time and patience. Two representative tape traces which show intermittent contact are given in Figure 5. For both traces the arrows beneath the traces point out the start of contact and the arrows above the traces point out the end of contact. The duration of a single contact is proportional to

room of 10 to 15 ft. — These low speeds were obtained by using a belt drive system in conjunction with the variable speed gear drive. The lowest steady rotational speed which could be maintained by the variable speed drive with the pulley combination used was 100 rpm. The highest speed of rotation which still maintained synchronization between the traces of individual contacts was about 1000 rpm. Speeds of rotation were measured by counting the synchronous light pulses with the rotating circuit recording clock traces at 100 rpm as a time pointer during one minute. Varying the circumferential distance by the total circumference of the circular assembly about the axis of rotation in 10 ft.

A section of the clock trace is shown in Figure 4. The three relatively large elements separated along were separated sufficiently to permit the fine structure between wire to act as a time spot on each trace. Attaining the proper amount of synchronization to obtain independent contact between the two traces required wire and the speed of rotation was a critical process which took considerable time and patience. Two representative tape traces with independent contacts are shown in Figure 5. The small circles and traces between the traces point out the point of contact and the above shows the traces point out the end of each trace. The definition of a small contact is approximately 10

the tape distance between the lines of action of any one lower arrow and the first upper arrow to the right of that lower arrow.

While measuring the size of individual contacts in sliding friction, it was decided to attempt to determine the effect of three variables:

1. Surface finish
2. Relative velocity (speed of rotation)
3. Load

To do this three sets of data were taken. Each set consisted of taking from five to seven tape recordings for a given surface finish, a given speed of rotation, and a range of loads (one tape for each load). For the first two sets of data the steel plate was finished with 2/0 emery paper. For the third set of data the steel plate was finished with #1 emery paper. In all cases the probe was undercut and finished with 2/0 emery paper. The first two sets of data were taken at the maximum difference in the speeds of rotation. The tabulated data for each of the 17 tape recordings is given in Appendix B.

In order to analyze the recorded data the following assumptions were made:

1. There is a single high spot on the probe contact wire.
2. The high spots on the steel plate and the high spot on the probe contact wire have spherical



the type relation between the lines at angles of any one  
lower angle and the line above it, the line of  
the line above.  
This means that the line at angles of any one  
in sliding position, it was decided to place in de-  
termining the effect of these variables.  
1. Surface Tension  
2. Relative velocity (speed of rotation)  
3. Load  
In the first case of data were taken, from the de-  
scribed of angles from five to seven degrees for  
a given surface tension, a given speed of rotation, and  
a range of loads (one type for each load). From the first  
two sets of data the first data was obtained with 5/8  
inch weight. For the third set of data the steel plate  
was finished with 1/2 inch weight. In all cases the  
gross was measured and obtained with 1/2 inch weight.  
The first two sets of data were taken at the same dis-  
tance in the angle of rotation. The second set  
for each of the 1/2 inch weight is given in appendix A.  
In order to explain the results data the follow-  
ing results were obtained:  
1. There is a definite line of the first set  
of data, and the line of the first set  
of data is the same as the line of the first set  
of data.

surfaces with the same radius of curvature.

3. The effect of the limited size of the probe contact wire high spot is negligible.
4. The effect of the deformation of the two high spots during their mutual crossing is negligible.

With these assumptions it follows that during the crossing the maximum area in contact is circular with a diameter equal to one half of the tape contact distance times the crossing speed divided by the tape speed.

That is:

$$\text{Contact diameter} = \frac{(\text{tape distance})(\text{crossing speed})}{2(\text{tape speed})} \quad (1)$$

Therefore, we have defined contact area as the maximum area in contact between two high spots during their mutual crossing.

The average of the contact diameters for each tape was computed by dividing the sum of the tape distance by the number of contacts and converting to contact diameter by equation (1).

The diameter of the average contact area for each tape was calculated using a statistical method to obtain the average tape distance squared and then, after taking the square root, converting to contact diameter by using equation (1).

entirely with the same value of constant.

3. The effect of the initial size of the group

constant with time is negligible.

4. The effect of the deformation of the two sides

is negligible during their mutual contact in equilibrium.

Table.

With these assumptions it follows that during the contact

the maximum rise in contact is identical with a rise

equal to one half of the total contact distance

which the particles spend divided of the time spent.

Thus we have:

$$(2) \quad \frac{1}{N} \sum_{i=1}^N \frac{1}{\tau_i} = \frac{1}{\tau} \quad \text{where } \tau_i \text{ is the contact time of particle } i \text{ and } \tau \text{ is the average contact time.}$$

Therefore, we have defined contact with its maximum

distance between two particles as the contact distance.

Mathematical treatment:

The number of the contact distance for each

particle is proportional to the sum of the two radii

times the number of contacts and proportional to the

total diameter of particles (1).

The diameter of the average group of size for each

size was calculated with a statistical method in which

the average size of the particles was taken as the basis

for the calculation of the average diameter of the

particles (1).



The statistical method can best be explained by referring to Table XXI. Twenty evenly spaced intervals of tape distance squared were used. In addition, the first interval was further broken down into ten evenly spaced intervals of distance squared. This additional breakdown was used to determine a more accurate mean value of tape distance squared for the first interval. The mean value of tape distance squared for all other intervals is defined as the average of the extreme tape distances squared for that interval. For all tapes the spacing of the intervals was such that the mean value of the tape distance squared for any one interval represented the same contact area for all tapes. Each of the few contact durations which did not fall within the twenty intervals was used as though it was the mean value of an interval containing that one contact duration.

The statistical method can only be explained by

reference to Table III. These results show that the

of size difference appeared very small. In addition, the

first interval was found to be very small. This interval

appeared intervals of distance appeared. This interval

appeared was used in calculating a more accurate value

value of size difference appeared for the first interval.

The mean value of size difference appeared for all other in-

tervals is defined as the average of the values size

difference appeared for that interval. For all other the

spacing of the intervals was such that the mean value of

the size difference appeared for any one interval value-

appeared the same constant value for all intervals. One of the

the constant quantities which did not vary with the

twenty intervals was used as follows: it was the mean value

of an interval containing that one constant quantity.



### III. RESULTS

The results of this investigation are given in Tables I and XX and in Figures 6, 7, and 8. The average diameter of the contact areas for each tape ranged from  $1.16 \times 10^{-4}$  cm to  $3.77 \times 10^{-4}$  cm. The diameter of the average area ranged from  $1.93 \times 10^{-4}$  cm to  $5.90 \times 10^{-4}$  cm.

Figure 6 shows the effect of relative velocity, loading, and surface finish on the average diameter of the contacts and on the diameter of the average contact area. The effect of these three variables is the same on both these diameters. Decreasing relative velocity decreases these diameters. Increasing loading with the 2/0 surface finish decreases these diameters. The coarser #1 surface finish tends to make the size of these diameters independent of loading.

The total number of contacts tabulated in Tables II through XIX is 3,169. Table XX shows that for these total contacts

2,493 have individual contact areas less than  $292 \times 10^{-8}$  cm<sup>2</sup>  
 2,524 have individual contact areas less than  $14.6 \times 10^{-8}$  cm<sup>2</sup>  
 1,558 have individual contact areas less than  $1.46 \times 10^{-8}$  cm<sup>2</sup>

This means that 80% of the contacts have diameters less than  $4.3 \times 10^{-4}$  cm, and about 50% of the contacts have diameters less than  $1.4 \times 10^{-4}$  cm. This size distribution of contact areas is given in Figures 7 and 8. These plots



show that a straight line relationship exists between the log of the number of contacts and the log of the average area for intervals of equal area.





#### IV. DISCUSSION OF RESULTS

The accuracy of the diameter calculations depends primarily upon the relation between the measured contact duration and the contact area. Equation (1) is exact, and therefore the calculated diameters are correct, provided that the assumptions given in the procedure are exact. Therefore, each assumption will be examined to determine its validity.

Assumption 1: There is a single high spot on the probe contact wire. An attempt was made to insure the exactness of this assumption by making the exposed end of contact wire as small as possible. The exposed end of the probe contact wire was an ellipse with the following measurements:

$$\text{major axis} = 5.2 \times 10^{-4} \text{ cm}$$

$$\text{minor axis} = 4.3 \times 10^{-4} \text{ cm}$$

This shows that the mean diameter of the exposed end of the probe contact wire is of the same order of magnitude as the diameter of the average contact area. Therefore, it is improbable that there is more than one high spot on the probe contact wire. Hence we can say that assumption 1 is probably exact.

Assumption 2: The high spots on the steel plate and the high spot on the probe contact wire have spherical surfaces with the same radius of curvature. Most previous

Therefore, each assumption will be assigned to a certain set of assumptions given in the procedure we want. Therefore the selected elements are defined, verified, modified and are defined again. Question (1) is about the definition and the relation between the measured quantity and the quantity of the element.

...le rôle de la femme dans la vie sociale ; l'éducation

Two contact wires are in place with the following data:

contact wire is small as possible. The exposed end of the  
extension of this connection by using the exposed end of  
single contact wire. An attempt was made to insure the

no. 101 x 5.2 = 520 vol. 10

This shows that the area element at the distance  $r$  from  
the point contact with it of the same order of magnitude  
as the diameter of the contact area. Therefore,  
it is impossible that there is more than one dipole on  
the plane contact area. Hence we can say that assumption  
is probably right.

See also: [List of all the other articles in this journal](#)

Love Festivals even with nothing more add up time that will

There are two main types of neurons:

investigators have used either hemispherical models or circular models for their investigation of contact area sizes. Therefore, it is felt that the assumption of spherical surfaces is a valid one provided that the plate surface is properly finished. To minimize the possibility of ridge shaped contact areas the plate surface was finished in two perpendicular directions. The effect of differences in the radii of curvature of the mutually crossing high spots upon the relation between contact duration and contact area will be negligible if the radii of curvature are large. According to previous investigations the angle of rise of the high spots is small. This means large radii of curvature of the spherical surfaces of the high spots. Consequently the effect of differences in radii of curvature on the relations between contact duration and contact area is negligible. Theoretically, while assumption 2 must be true for equation (1) to be exact, actually, the differences in radii of curvature have a negligible effect on the calculated values of contact diameters.

Assumption 3: The effect of the limited size of the probe contact wire high spot is negligible. The maximum area in contact during a crossing is actually limited to the area of the end of the probe contact wire. This area is about  $17.7 \times 10^{-5} \text{cm}^2$ . Approximately 20% of the total number of the contacts have contact areas which are greater. We are actually interested in measuring the contact area



Investigations have been made with theoretical models of  
circular motion for their investigation of motion of  
atoms. Therefore, it is not for the purpose of  
physical purpose is a valid one. However, the fact  
motion is purely linear. In addition, the possibility  
of large angular motion of the atoms is not  
taken in the theoretical treatment. The effect of all-  
formers in the field of motion of the atoms is  
the same as the relation between motion of motion  
and motion will be possible in the field of mo-  
tion of atoms. According to previous investigations  
the motion of the atoms of the atoms is small. This means  
large field of motion of the atoms of motion of the  
atoms. Consequently, the effect of differences in  
field of motion on the relation between motion of  
the atoms is negligible. Therefore, motion  
of motion is not for motion (1) to be small,  
motion, the difference in field of motion is  
negligible effect on the calculated values of motion of  
atoms.

doi:10.1017/S0022292412001904

These contacts were made in 1951. The maximum size in contact during a flooding is actually limited by the size of the bed of the river contact area. This area is about  $1.5 \times 10^{-2} \text{ km}^2$ . Approximately 20% of the total number of the contacts have contact areas more than 1000 m<sup>2</sup> in size. The contacts are generally distributed in a regular manner.



which would exist if the size of the probe contact wire high spot was not limited. The fact that the contact wire size is so small means that the larger 20% of diameters calculated using equation (1) would be smaller than the diameters that we are interested in calculating. The larger 20% of the contact durations add considerably to the size of the calculated average diameter of contact and the calculated diameter of the average area. Therefore, the limited size of the probe probably has a significant effect on these two calculated averages.

Assumption 4: The effect of the deformation of the two high spots during their mutual crossing is negligible. The hard tungsten probe contact wire will resist deformation. Hence the deformation will be limited to the 1045 steel plate. Limiting the deformation to one high spot will reduce the effect of deformation on contact durations. The effect of any deformation which does take place will be to increase the contact duration. This would cause the calculations to predict larger contact sizes than actually exist. Whether or not the effect of deformation on contact duration introduces significant error into the calculations is not known.

In order better to evaluate the significance of the calculated sizes of the contacts it is recommended that further investigation be made to determine the effect of the deformation of contacts on the contact durations. Nevertheless we can say that equation (1) gives an order of magni-

which would exist if the size of the drop contact with the steel was not limited. The fact that the contact size is so small, again from Figure 2, of the sphere calculated using equation (1) would be similar to the diameter that we are interested in calculating. The larger size of the contact between the sphere and the steel is the size of the calculated sphere diameter of contact and the calculated diameter of the sphere steel. Therefore, the limited size of the sphere (which) has a significant effect on these two calculated diameters.

#### Assumption 2: The effect of the deformation of the

the steel sphere during the contact deformation is negligible.

The steel sphere is assumed to be rigid and will not deform. Since the deformation will be limited to the size of the steel sphere, the deformation is negligible. It will reduce the effect of deformation on contact diameters. The effect of any deformation which does occur will be to increase the contact diameter. This would cause the calculations to predict larger contact size than actually exist. Therefore, on the effect of deformation on contact diameter, deformation significantly errors into the calculations is not known.

In order better to estimate the significance of the calculated size of the contact it is recommended that further investigation be made to determine the effect of the deformation of contact on the calculated diameter. However, it is not possible to give an order of magnitude.

tude approximation of the contact diameter. Therefore, we conclude that:

1. The average of the diameters of individual contact areas has an order of magnitude between  $1 \times 10^{-4}$  cm and  $4 \times 10^{-4}$  cm.
2. The diameter of the average area of the individual contact areas has an order of magnitude between  $2 \times 10^{-4}$  cm and  $6 \times 10^{-4}$  cm.

It is obvious from the scatter of the data plotted in Figure 6 that the exact effects of the relative velocity, surface finish, and loading on the size of contact areas have not been determined. Therefore, it is recommended that further investigation be made to determine the effect of variables such as these on the size of contact areas. These plots do show general trends of the effects of relative velocity, surface finish, and loading on the size of contact areas. Therefore, we conclude that:

1. Increasing the relative velocity of the surfaces in contact probably increases the size of individual contact in sliding friction.
2. Increasing the loading probably decreases the size of individual contacts in sliding friction for surfaces finished with 2/0 emery paper.
3. Increasing the roughness of the surface finish probably tends to eliminate the effect of loading on the size of individual contact in sliding friction.



12  
The investigation of the contact system. Therefore,  
we consider first:

1. The system of the interaction of individual

contact areas and the order of magnitude of

forces  $F \sim 10^{-4}$  to  $10^{-5}$  dy.

2. The character of the average state of the in-

dividual contact areas and the order of magi-

tude between  $F \sim 10^{-4}$  to  $10^{-5}$  dy.

It is obvious from the content of the data listed

in Figure 1 that the state of the relative motion

is, surface friction, and loading on the side of contact

areas have not been determined. Therefore, it is neces-

sary to make further investigation on each of the above

effects of contact areas and on those on the side of contact

areas. These data on the general trends of the effects

of relative velocity, surface friction, and loading on the

side of contact areas. Therefore, we consider first:

1. Investigating the relative velocity of the surfaces

in contact probably increases the size of in-

dividual contact in sliding motion.

2. Investigating the loading probably decreases the

size of individual contacts in sliding motion

for surfaces finished with 5/0 sand paper.

3. Investigating the roughness of the surface finish

probably leads to different size of in-

dividual contact in sliding motion.

Investigation.



Figures 7 and 8 show the size distribution of contact areas. The solid line in Figure 7 is a plot of the number of contacts in each of twenty even area intervals versus the mean area of each interval. In the intervals which contain large area contacts the ratio of the mean area of the interval to the average diameter of the interval is relatively close to unity. In the intervals which contain the small area contacts the ratio may be much greater than unity. Therefore, the solid line in Figure 7 is not a true representation of the size distribution of contact areas since the mean areas plotted for the intervals containing the small contact areas are considerably larger than the average area of the contacts in those intervals. The average area of the first of the twenty intervals was calculated by breaking that interval into ten evenly spaced area intervals and statistically computing the average area for the first interval. This results in the plotted point indicated by the arrow in Figure 7. Since the ratio of mean area to average contact area approaches unity as the intervals containing the larger contact areas are approached, it is postulated that the result of plotting the number of contacts in each interval versus the average contact area for each interval would be the dashed line in Figure 7. This postulation is corroborated by the plot of the size distribution of the contact areas in the first interval which is given in

Figure 1 and 2 show the size distribution of some  
 last years. The solid line in Figure 1 is a plot of the  
 number of contacts in each of twenty even size intervals  
 versus the mean size of each interval. In the intervals  
 which contain fewer than five contacts the ratio of the mean  
 size of the interval to the average size of the interval  
 was relatively close to unity. In the intervals which  
 contain five or more contacts the ratio may be shown  
 to be less than unity. Therefore, the solid line in Figure  
 1 is not a true representation of the size distribution  
 of contacts even though the mean sizes plotted for the in-  
 tervals containing five or more contacts are approximately  
 equal to the average size of the contacts in those in-  
 tervals. The average size of the first of the twenty in-  
 tervals was calculated by dividing the total interval into ten  
 evenly spaced size intervals and statistically averaging  
 the results over the first interval. This results in  
 the plotted point indicated by the arrow in Figure 1.  
 Since the ratio of mean size to average contact size ap-  
 proaches unity as the intervals containing the larger con-  
 tact sizes are approached, it is concluded that the re-  
 sults of dividing the number of contacts in each interval  
 versus the average contact size for each interval would be  
 the same as in Figure 1. This conclusion is con-  
 firmed by the plot of the size distribution of the  
 contacts shown in the first interval shown in Figure 1.

Figure 8. The slope of the straight line plot in Figure 8 is equal to the slope of the dashed line plot in Figure 7. The mean area was used as the basis for this plot. However, since the area intervals are much smaller in this case, the ratio of mean area to average contact area for all intervals will be much closer to unity. Therefore, the plot given in Figure 8 is a good representation of the size distribution of contact areas.

We conclude that the distribution of contact areas is such that the log of the number of contacts bears a straight line relationship to the log of the average area for intervals of equal areas. Table XX shows the contact area distribution for all tapes. From Table XX we conclude that:

1. About 80% of the contact areas have diameters less than  $4.3 \times 10^{-5}$  cm.
2. About 50% of the contact areas have diameters less than  $1.4 \times 10^{-5}$  cm.

It is recommended that further statistical analysis of the tabulated data should be made for the purpose of explaining the size distribution of the contact areas.



[illegible]



## V. CONCLUSIONS

1. The average of the diameters of individual contact areas has an order of magnitude between  $1 \times 10^{-4}$  cm and  $4 \times 10^{-4}$  cm.

2. The diameter of the average area of the individual contact areas has an order of magnitude between  $2 \times 10^{-4}$  cm and  $6 \times 10^{-4}$  cm.

3. Increasing the relative velocity of the surfaces in contact probably increases the size of individual contacts in sliding friction.

4. Increasing the loading probably decreases the size of individual contacts in sliding friction for surfaces finished with 2/0 emery paper.

5. Increasing the roughness of the surface finish probably tends to eliminate the effect of loading on the size of individual contacts in sliding friction.

6. The distribution of contact areas is such that the log of the number of contacts bears a straight line relationship to the log of the average area for intervals of equal area.

7. About 80% of the contact areas have diameters less than  $4.3 \times 10^{-5}$  cm.

8. About 50% of the contact areas have diameters less than  $1.4 \times 10^{-5}$  cm.

1. The average of the squares of individual scores

... ..

5. The diameter of the ventral side of the left-

viewed, empirical work has an obligation to

...  $\lambda = 0.5$  ...

Increasing the relative velocity of the surfaces

— 1995 / 1996 / 1997 / 1998 / 1999 / 2000 / 2001 / 2002 / 2003 / 2004 / 2005 / 2006 / 2007 / 2008 / 2009 / 2010 / 2011 / 2012 / 2013 / 2014 / 2015 / 2016 / 2017 / 2018 / 2019 / 2020 / 2021 / 2022 / 2023 / 2024 / 2025 / 2026 / 2027 / 2028 / 2029 / 2030 / 2031 / 2032 / 2033 / 2034 / 2035 / 2036 / 2037 / 2038 / 2039 / 2040 / 2041 / 2042 / 2043 / 2044 / 2045 / 2046 / 2047 / 2048 / 2049 / 2050 / 2051 / 2052 / 2053 / 2054 / 2055 / 2056 / 2057 / 2058 / 2059 / 2060 / 2061 / 2062 / 2063 / 2064 / 2065 / 2066 / 2067 / 2068 / 2069 / 2070 / 2071 / 2072 / 2073 / 2074 / 2075 / 2076 / 2077 / 2078 / 2079 / 2080 / 2081 / 2082 / 2083 / 2084 / 2085 / 2086 / 2087 / 2088 / 2089 / 2090 / 2091 / 2092 / 2093 / 2094 / 2095 / 2096 / 2097 / 2098 / 2099 / 2100 / 2101 / 2102 / 2103 / 2104 / 2105 / 2106 / 2107 / 2108 / 2109 / 2110 / 2111 / 2112 / 2113 / 2114 / 2115 / 2116 / 2117 / 2118 / 2119 / 2120 / 2121 / 2122 / 2123 / 2124 / 2125 / 2126 / 2127 / 2128 / 2129 / 2130 / 2131 / 2132 / 2133 / 2134 / 2135 / 2136 / 2137 / 2138 / 2139 / 2140 / 2141 / 2142 / 2143 / 2144 / 2145 / 2146 / 2147 / 2148 / 2149 / 2150 / 2151 / 2152 / 2153 / 2154 / 2155 / 2156 / 2157 / 2158 / 2159 / 2160 / 2161 / 2162 / 2163 / 2164 / 2165 / 2166 / 2167 / 2168 / 2169 / 2170 / 2171 / 2172 / 2173 / 2174 / 2175 / 2176 / 2177 / 2178 / 2179 / 2180 / 2181 / 2182 / 2183 / 2184 / 2185 / 2186 / 2187 / 2188 / 2189 / 2190 / 2191 / 2192 / 2193 / 2194 / 2195 / 2196 / 2197 / 2198 / 2199 / 2200 / 2201 / 2202 / 2203 / 2204 / 2205 / 2206 / 2207 / 2208 / 2209 / 2210 / 2211 / 2212 / 2213 / 2214 / 2215 / 2216 / 2217 / 2218 / 2219 / 2220 / 2221 / 2222 / 2223 / 2224 / 2225 / 2226 / 2227 / 2228 / 2229 / 2230 / 2231 / 2232 / 2233 / 2234 / 2235 / 2236 / 2237 / 2238 / 2239 / 2240 / 2241 / 2242 / 2243 / 2244 / 2245 / 2246 / 2247 / 2248 / 2249 / 2250 / 2251 / 2252 / 2253 / 2254 / 2255 / 2256 / 2257 / 2258 / 2259 / 2260 / 2261 / 2262 / 2263 / 2264 / 2265 / 2266 / 2267 / 2268 / 2269 / 2270 / 2271 / 2272 / 2273 / 2274 / 2275 / 2276 / 2277 / 2278 / 2279 / 2280 / 2281 / 2282 / 2283 / 2284 / 2285 / 2286 / 2287 / 2288 / 2289 / 2290 / 2291 / 2292 / 2293 / 2294 / 2295 / 2296 / 2297 / 2298 / 2299 / 2300 / 2301 / 2302 / 2303 / 2304 / 2305 / 2306 / 2307 / 2308 / 2309 / 2310 / 2311 / 2312 / 2313 / 2314 / 2315 / 2316 / 2317 / 2318 / 2319 / 2320 / 2321 / 2322 / 2323 / 2324 / 2325 / 2326 / 2327 / 2328 / 2329 / 2330 / 2331 / 2332 / 2333 / 2334 / 2335 / 2336 / 2337 / 2338 / 2339 / 2340 / 2341 / 2342 / 2343 / 2344 / 2345 / 2346 / 2347 / 2348 / 2349 / 2350 / 2351 / 2352 / 2353 / 2354 / 2355 / 2356 / 2357 / 2358 / 2359 / 2360 / 2361 / 2362 / 2363 / 2364 / 2365 / 2366 / 2367 / 2368 / 2369 / 2370 / 2371 / 2372 / 2373 / 2374 / 2375 / 2376 / 2377 / 2378 / 2379 / 2380 / 2381 / 2382 / 2383 / 2384 / 2385 / 2386 / 2387 / 2388 / 2389 / 2390 / 2391 / 2392 / 2393 / 2394 / 2395 / 2396 / 2397 / 2398 / 2399 / 2400 / 2401 / 2402 / 2403 / 2404 / 2405 / 2406 / 2407 / 2408 / 2409 / 2410 / 2411 / 2412 / 2413 / 2414 / 2415 / 2416 / 2417 / 2418 / 2419 / 2420 / 2421 / 2422 / 2423 / 2424 / 2425 / 2426 / 2427 / 2428 / 2429 / 2430 / 2431 / 2432 / 2433 / 2434 / 2435 / 2436 / 2437 / 2438 / 2439 / 2440 / 2441 / 2442 / 2443 / 2444 / 2445 / 2446 / 2447 / 2448 / 2449 / 2450 / 2451 / 2452 / 2453 / 2454 / 2455 / 2456 / 2457 / 2458 / 2459 / 2460 / 2461 / 2462 / 2463 / 2464 / 2465 / 2466 / 2467 / 2468 / 2469 / 2470 / 2471 / 2472 / 2473 / 2474 / 2475 / 2476 / 2477 / 2478 / 2479 / 2480 / 2481 / 2482 / 2483 / 2484 / 2485 / 2486 / 2487 / 2488 / 2489 / 2490 / 2491 / 2492 / 2493 / 2494 / 2495 / 2496 / 2497 / 2498 / 2499 / 2500 / 2501 / 2502 / 2503 / 2504 / 2505 / 2506 / 2507 / 2508 / 2509 / 2510 / 2511 / 2512 / 2513 / 2514 / 2515 / 2516 / 2517 / 2518 / 2519 / 2520 / 2521 / 2522 / 2523 / 2524 / 2525 / 2526 / 2527 / 2528 / 2529 / 2530 / 2531 / 2532 / 2533 / 2534 / 2535 / 2536 / 2537 / 2538 / 2539 / 2540 / 2541 / 2542 / 2543 / 2544 / 2545 / 2546 / 2547 / 2548 / 2549 / 2550 / 2551 / 2552 / 2553 / 2554 / 2555 / 2556 / 2557 / 2558 / 2559 / 2560 / 2561 / 2562 / 2563 / 2564 / 2565 / 2566 / 2567 / 2568 / 2569 / 2570 / 2571 / 2572 / 2573 / 2574 / 2575 / 2576 / 2577 / 2578 / 2579 / 2580 / 2581 / 2582 / 2583 / 2584 / 2585 / 2586 / 2587 / 2588 / 2589 / 2590 / 2591 / 2592 / 2593 / 2594 / 2595 / 2596 / 2597 / 2598 / 2599 / 2600 / 2601 / 2602 / 2603 / 2604 / 2605 / 2606 / 2607 / 2608 / 2609 / 2610 / 2611 / 2612 / 2613 / 2614 / 2615 / 2616 / 2617 / 2618 / 2619 / 2620 / 2621 / 2622 / 2623 / 2624 / 2625 / 2626 / 2627 / 2628 / 2629 / 2630 / 2631 / 2632 / 2633 / 2634 / 2635 / 2636 / 2637 / 2638 / 2639 / 2640 / 2641 / 2642 / 2643 / 2644 / 2645 / 2646 / 2647 / 2648 / 2649 / 2650 / 2651 / 2652 / 2653 / 2654 / 2655 / 2656 / 2657 / 2658 / 2659 / 2660 / 2661 / 2662 / 2663 / 2664 / 2665 / 2666 / 2667 / 2668 / 2669 / 2670 / 2671 / 2672 / 2673 / 2674 / 2675 / 2676 /

4. *Explain the importance of the following:*

There are no individual contracts in place for the year.

• *any other* is also possible

5. Information for members of the various clubs

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Issue of individual contacts in within trials.

5. For classification of persons who are not

will identify a water supply to which all the

relational) is the only one of the systems that is

1994 June 30

The above list of the objects were more numerous

[illegible]

1. About 50% of the patients with low platelets

1998-1999

## VI. RECOMMENDATIONS

1. Further investigation should be made to determine the effect of the deformation of contacts on the contact durations.

2. Further investigation should be made to determine the effect of variables such as relative velocity, surface finish, and loading on the size of individual contacts in sliding friction.

3. Further statistical analysis of the tabulated data should be made for the purpose of explaining the size distribution of the contact areas.

# VI. DISCUSSION

1. The first investigation should be made to determine the effect of the various factors on the rate of reaction.

2. Further investigation should be made to determine the effect of various factors such as relative velocity, surface area, and loading on the rate of reaction.

3. Further investigation should be made to determine the effect of various factors such as relative velocity, surface area, and loading on the rate of reaction.

4. Further investigation should be made to determine the effect of various factors such as relative velocity, surface area, and loading on the rate of reaction.

5. Further investigation should be made to determine the effect of various factors such as relative velocity, surface area, and loading on the rate of reaction.

6. Further investigation should be made to determine the effect of various factors such as relative velocity, surface area, and loading on the rate of reaction.



VII. APPENDIX

# THE THE

THE

## APPENDIX A

## Pictures of Experimental Set Up and Sketch of Probe

	Page
Figure 1. Picture, Over All Experimental Set Up ...	A 2
Figure 2. Picture, Side View of Wear Machine .....	A 3
Figure 3. Picture, Close Up of Mounted Probe .....	A 4
Figure 4. Sketch of Probe .....	A 5

# REFERENCES

1. J. H. Van Vleet, *et al.*, *Journal of the American Veterinary Medical Association*, 1974, 126: 1000-1002.

2. J. H. Van Vleet, *et al.*, *Journal of the American Veterinary Medical Association*, 1975, 128: 1000-1002.

3. J. H. Van Vleet, *et al.*, *Journal of the American Veterinary Medical Association*, 1976, 130: 1000-1002.

4. J. H. Van Vleet, *et al.*, *Journal of the American Veterinary Medical Association*, 1977, 132: 1000-1002.

5. J. H. Van Vleet, *et al.*, *Journal of the American Veterinary Medical Association*, 1978, 134: 1000-1002.

6. J. H. Van Vleet, *et al.*, *Journal of the American Veterinary Medical Association*, 1979, 136: 1000-1002.



Figure I  
Over All Experimental Set Up

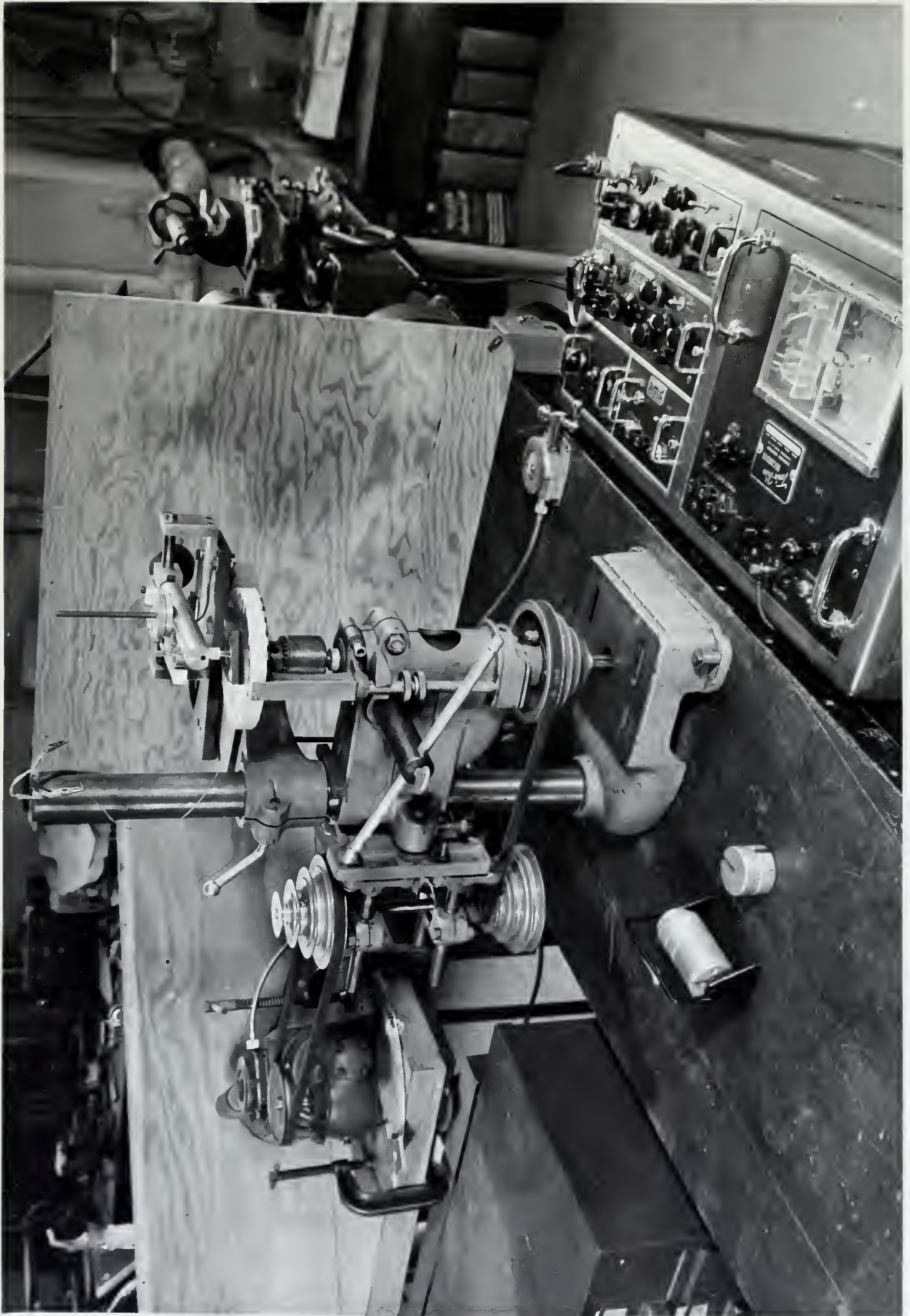




Figure II  
Side View of Wear Machine

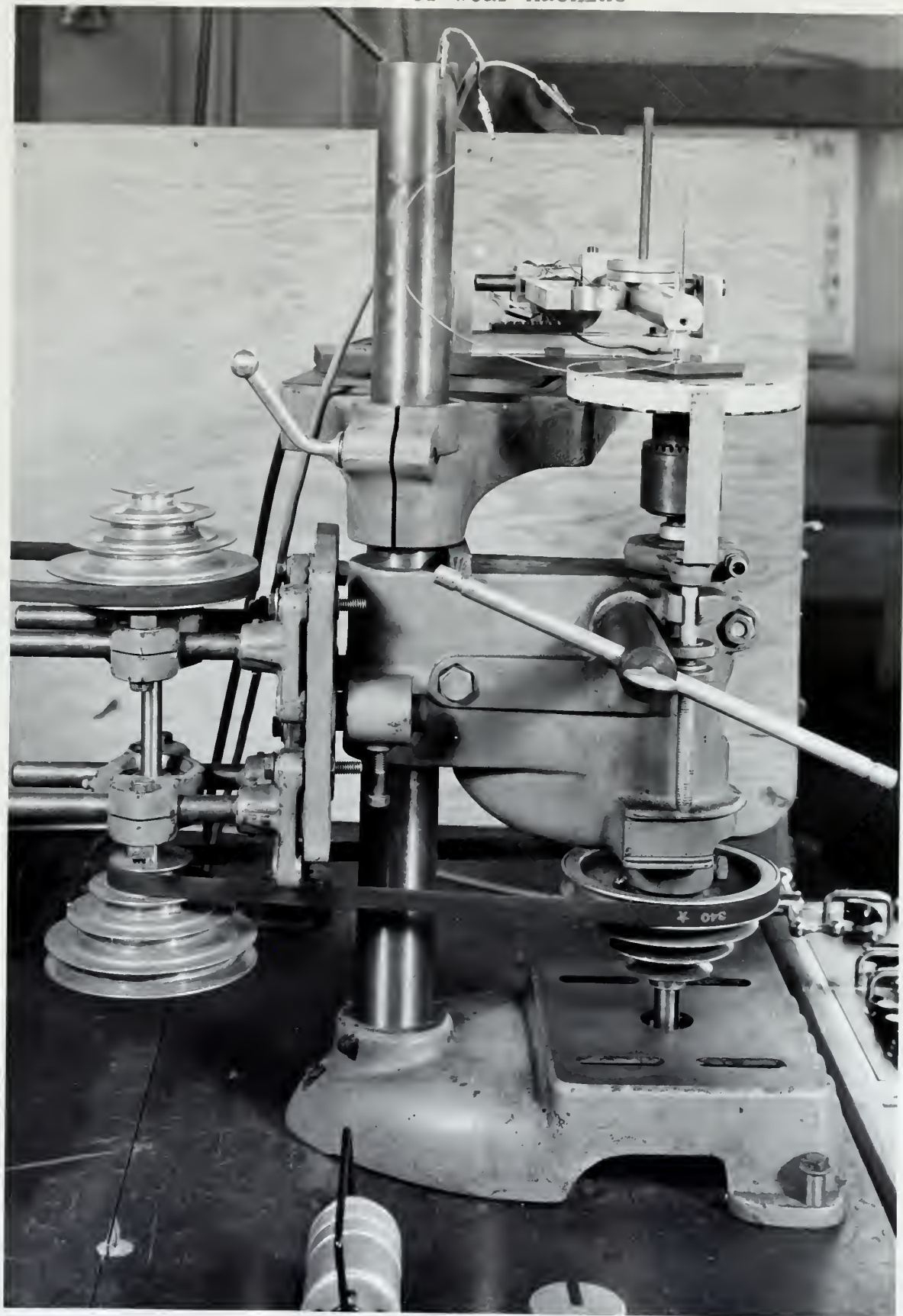






Figure III  
Close Up of Mounted Probe

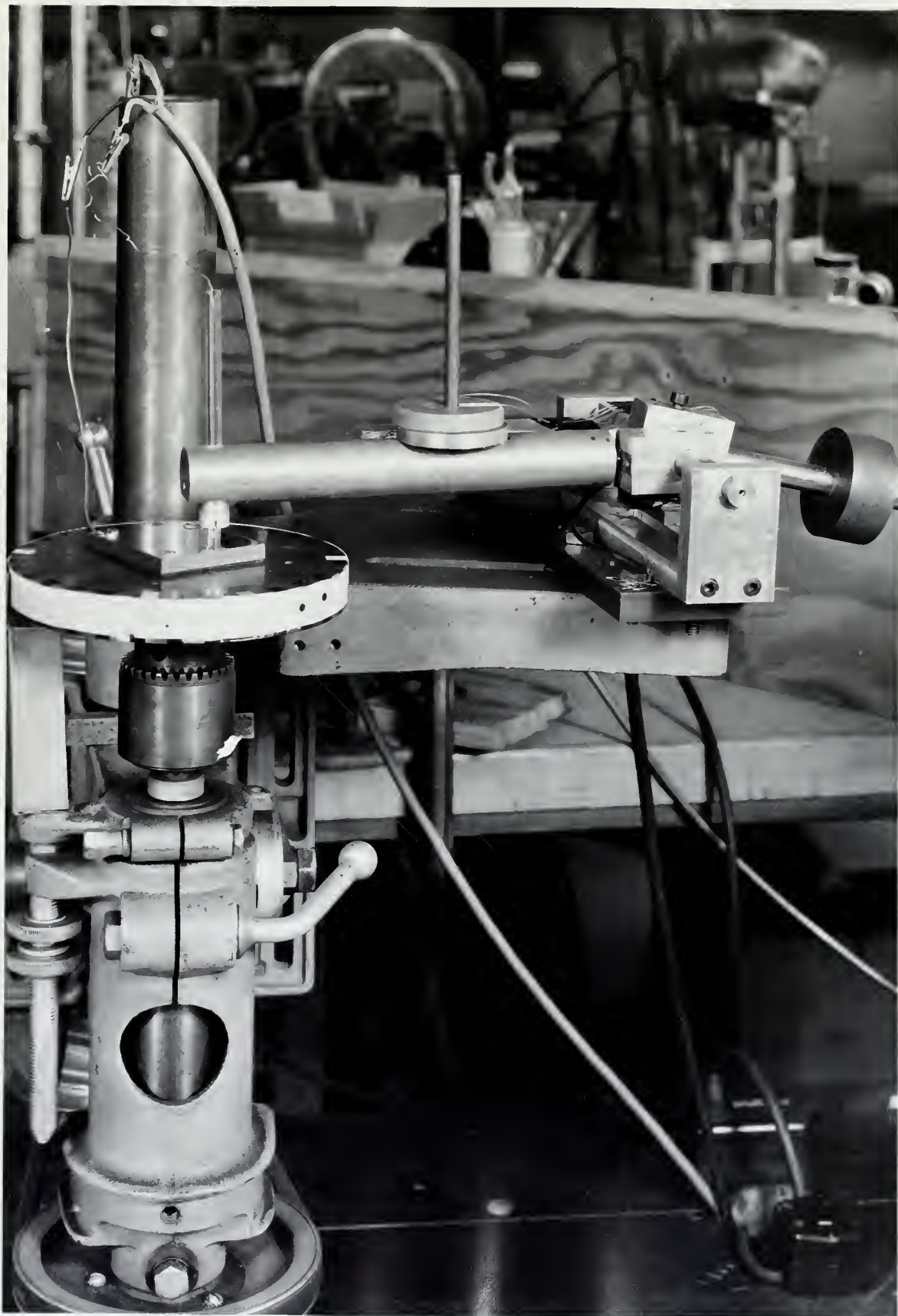
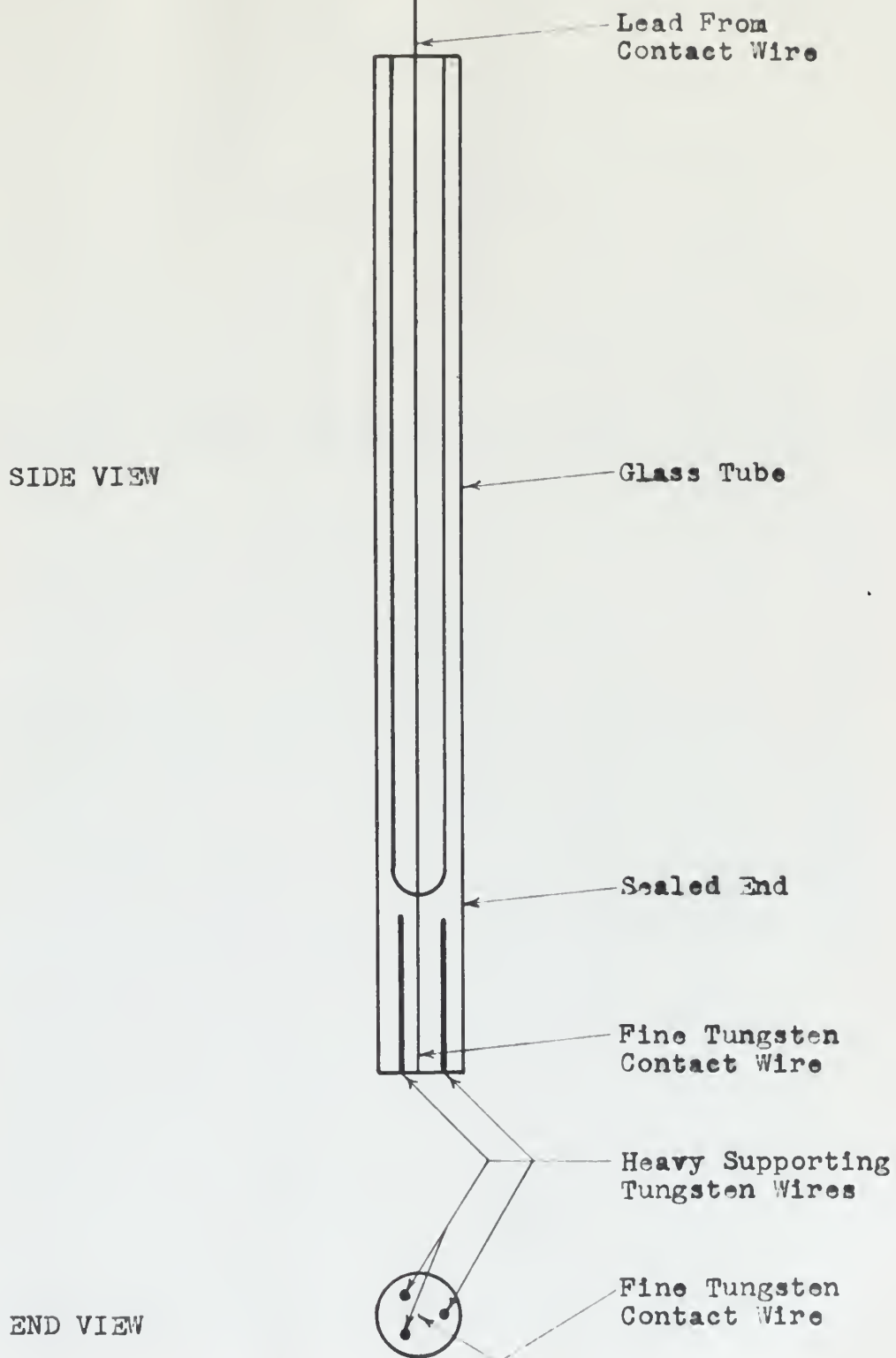




Figure IV

GLASS PROBE (Double the actual size)





APPENDIX B  
Representative Tape

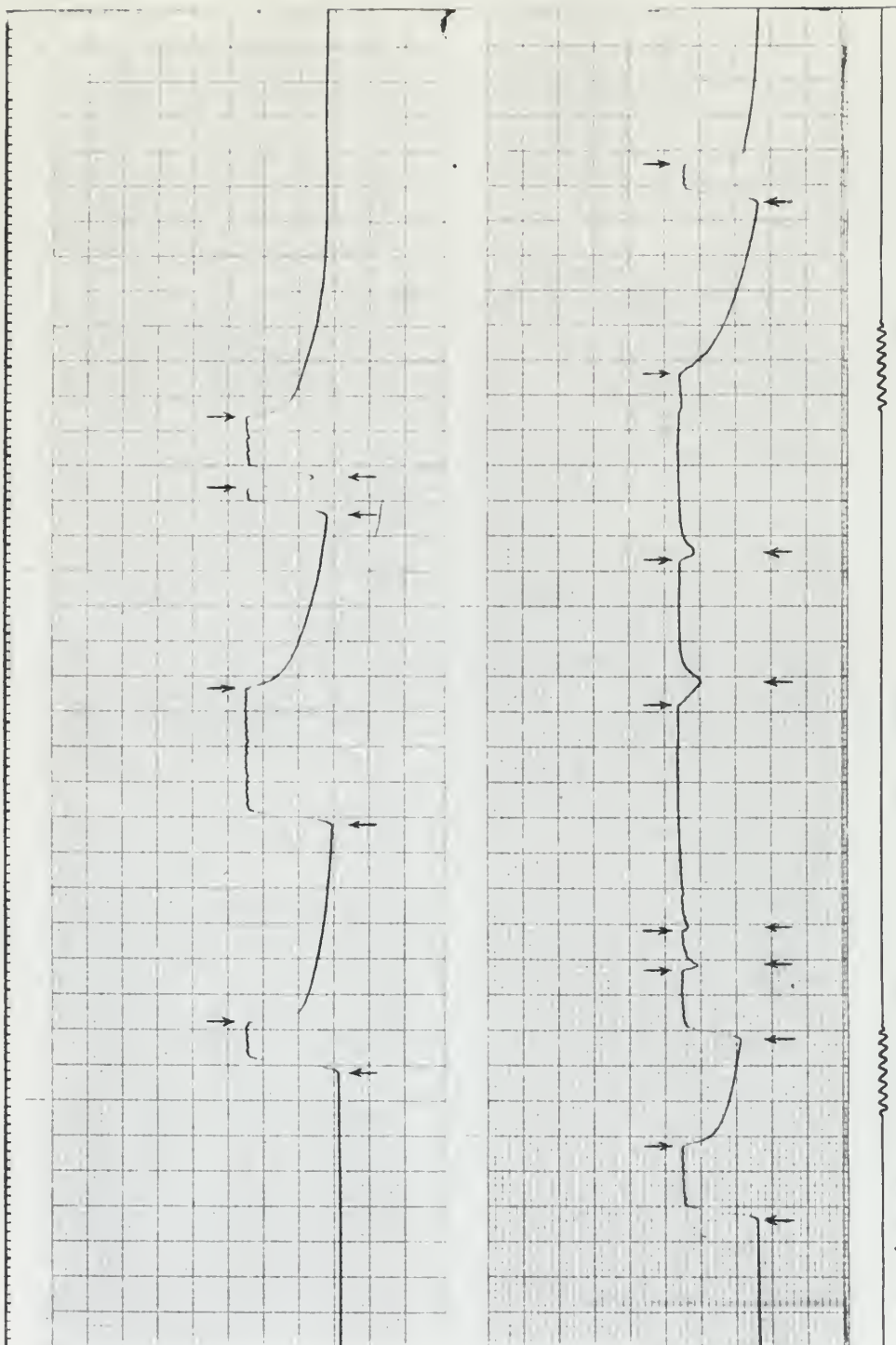
	Page
Figure 5. Picture, Representative Tape .....	A 7

# THE HISTORY OF

THE UNITED STATES OF AMERICA

1776

THE HISTORY OF THE UNITED STATES OF AMERICA, FROM 1776 TO 1876

Figure V

REPRESENTATIVE TAPE TRACES





## APPENDIX C

## Graphs of Results

	Page
Figure 6. Plot, Average Contact Diameter v.s. Load .....	A 9
Figure 7. Plot, Size Distribution of Contact Areas for All Tapes .....	A 10
Figure 8. Plot, Size Distribution of Contact Areas with Diameters Less Than Probe Diameter .....	A 11

# APPENDIX

## TABLE OF CONTENTS

Page

Figure 1. Plot, average contact diameter, etc.

..... 1

Figure 2. Plot, size distribution of contact

..... 2

Figure 3. Plot, size distribution of contact

..... 3

..... 4

Figure VI

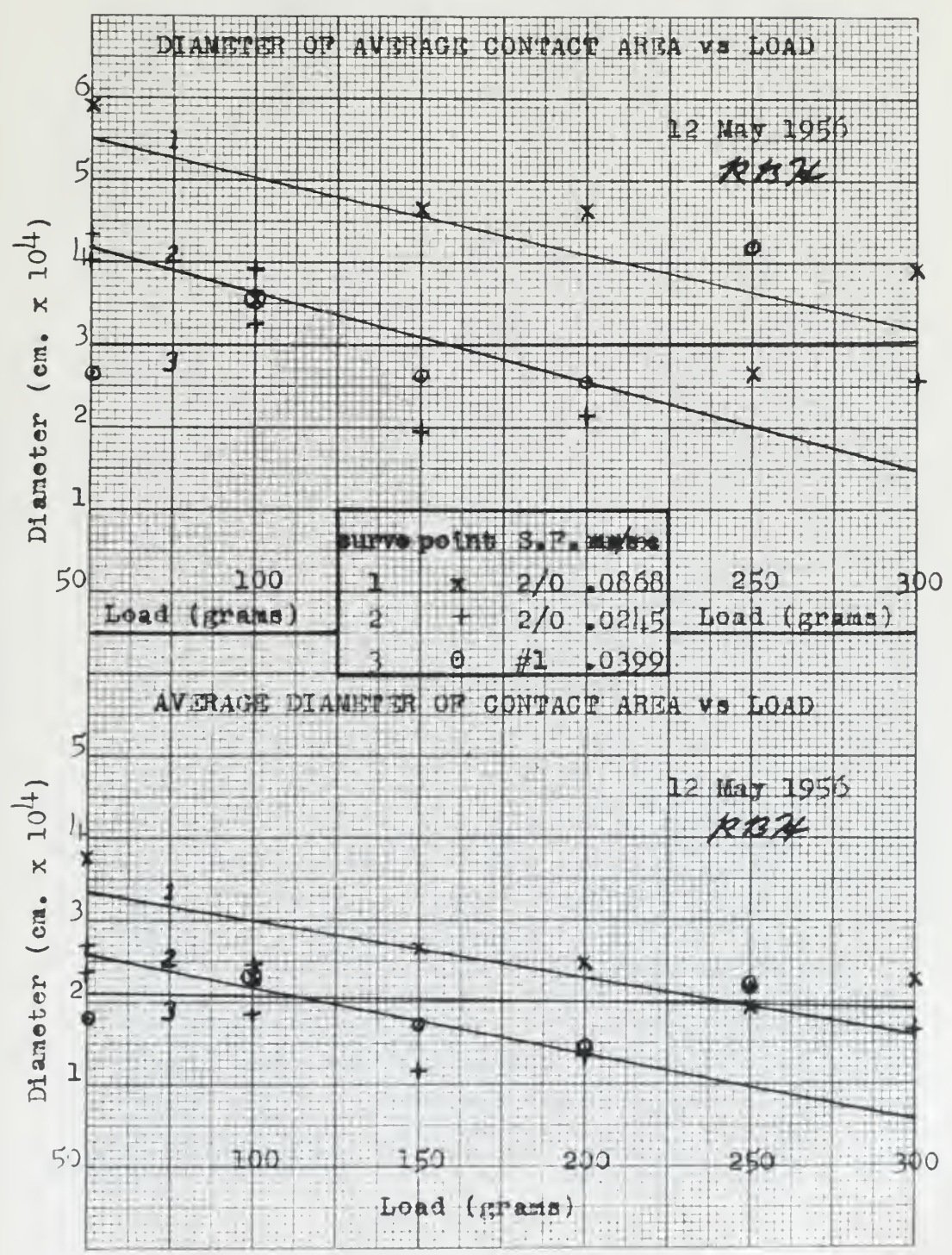






Figure VII

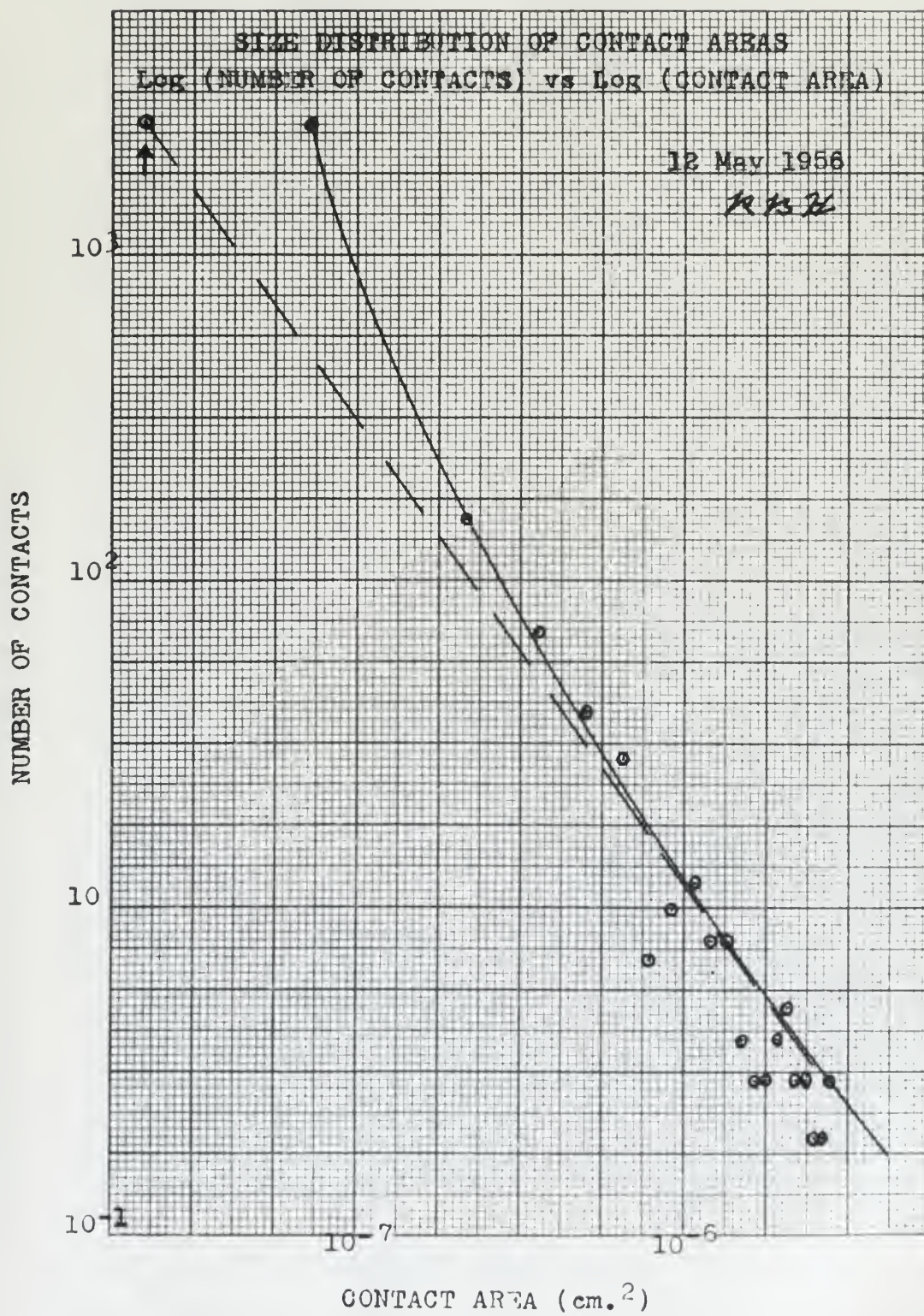
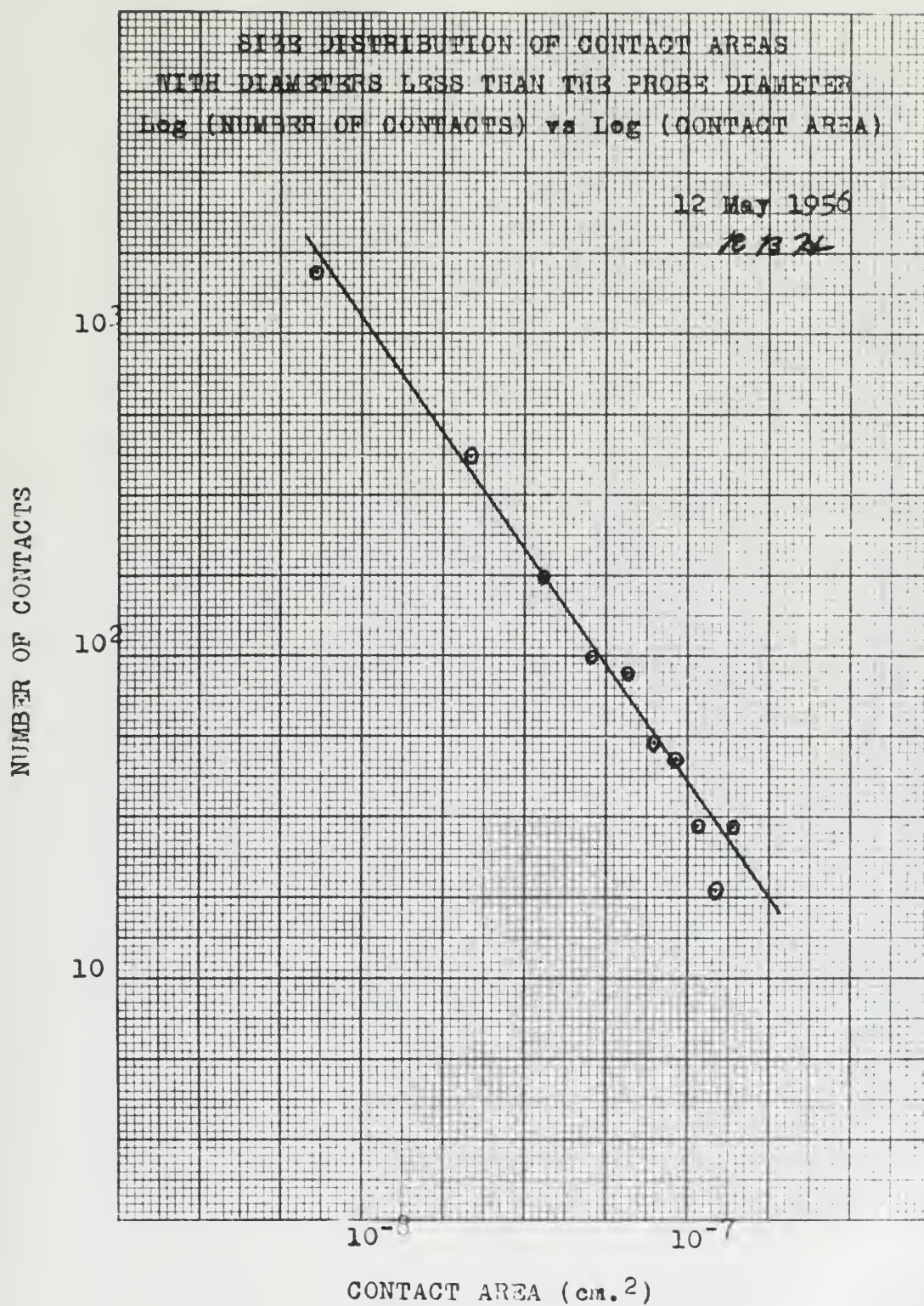






Figure VIII





## APPENDIX D

## Identification of Tapes - Tabulated Data

		Page
Table	I. Identification of Tapes and Summary of Calculations .....	A 13
Table	II. Tabulated Data, Tape 1 .....	A 14
Table	III. Tabulated Data, Tape 2 .....	A 15
Table	IV. Tabulated Data, Tape 3 .....	A 17
Table	V. Tabulated Data, Tape 4 .....	A 18
Table	VI. Tabulated Data, Tape 5 .....	A 20
Table	VII. Tabulated Data, Tape 6 .....	A 23
Table	VIII. Tabulated Data, Tape 7 .....	A 25
Table	IX. Tabulated Data, Tape 8 .....	A 27
Table	X. Tabulated Data, Tape 9 .....	A 31
Table	XI. Tabulated Data, Tape 10 .....	A 33
Table	XII. Tabulated Data, Tape 11 .....	A 36
Table	XIII. Tabulated Data, Tape 12 .....	A 38
Table	XIV. Tabulated Data, Tape 13 .....	A 40
Table	XV. Tabulated Data, Tape 14 .....	A 42
Table	XVI. Tabulated Data, Tape 15 .....	A 44
Table	XVII. Tabulated Data, Tape 16 .....	A 46
Table	XVIII. Tabulated Data, Tape 17 .....	A 47
Table	XIX. Tabulated Data, Tape 18 .....	A 50



# APPENDIX II

## Identification of Types - Tabulated Data

Table	1. Identification of Types and	Page
Table I	Summary of Classifications	17
Table II	Tabulated Data, Type I	18
Table III	Tabulated Data, Type II	19
Table IV	Tabulated Data, Type III	20
Table V	Tabulated Data, Type IV	21
Table VI	Tabulated Data, Type V	22
Table VII	Tabulated Data, Type VI	23
Table VIII	Tabulated Data, Type VII	24
Table IX	Tabulated Data, Type VIII	25
Table X	Tabulated Data, Type IX	26
Table XI	Tabulated Data, Type X	27
Table XII	Tabulated Data, Type XI	28
Table XIII	Tabulated Data, Type XII	29
Table XIV	Tabulated Data, Type XIII	30
Table XV	Tabulated Data, Type XIV	31
Table XVI	Tabulated Data, Type XV	32
Table XVII	Tabulated Data, Type XVI	33
Table XVIII	Tabulated Data, Type XVII	34
Table XIX	Tabulated Data, Type XVIII	35

Table I

## IDENTIFICATION OF TAPES AND SUMMARY OF DIAMETER CAL-

TAPES No.	SURFACE FINISH	LOAD	CORRELATIONS		DIAMETER OF AVERAGE AREA $\times 10^{-4}$ cm
			VELOCITY $\times 10^2$ mm/sec	AVERAGE DIAMETER $\times 10^{-4}$ cm	
1	2/0	100	2.45	2.37	4.01
2	2/0	100		1.87	4.33
3	2/0	200		2.70	3.24
4	2/0	200		2.46	3.92
5	2/0	300		1.46	1.93
6	2/0	400		1.34	2.13
7	2/0	600		1.67	2.55
8	2/0	100	8.68	3.77	5.90
9	2/0	200		2.30	3.53
10	2/0	300		2.63	4.66
11	2/0	400		2.47	4.62
12	2/0	500		1.93	2.66
13	2/0	600		2.28	3.91
14	1	100	3.99	1.81	2.67
15	1	200		2.33	3.58
16	1	300		1.74	2.61
17	1	400		1.43	2.55
18	1	500		2.21	4.19

## TABLE 1

THERMAL STABILITY OF POLYMERIZATION OF VINYL MONOMERS

## POLYMERIZATION

TABLE NO.	MONOMER	INITIAL CONC. $\times 10^3$ mol/l.	INITIAL TEMP. $^{\circ}\text{C}$	INITIAL RATE $\times 10^3$ mol/l.hr.	INITIAL PERIOD $\times 10^3$ hr.
1	Styrene	5.0	100	1.42	1.11
2	Styrene	5.0	100	1.81	1.12
3	Styrene	5.0	100	2.10	1.13
4	Styrene	5.0	100	2.40	1.14
5	Styrene	5.0	100	2.70	1.15
6	Styrene	5.0	100	3.00	1.16
7	Styrene	5.0	100	3.30	1.17
8	Styrene	5.0	100	3.60	1.18
9	Styrene	5.0	100	3.90	1.19
10	Styrene	5.0	100	4.20	1.20
11	Styrene	5.0	100	4.50	1.21
12	Styrene	5.0	100	4.80	1.22
13	Styrene	5.0	100	5.10	1.23
14	Styrene	5.0	100	5.40	1.24
15	Styrene	5.0	100	5.70	1.25
16	Styrene	5.0	100	6.00	1.26
17	Styrene	5.0	100	6.30	1.27
18	Styrene	5.0	100	6.60	1.28
19	Styrene	5.0	100	6.90	1.29
20	Styrene	5.0	100	7.20	1.30
21	Styrene	5.0	100	7.50	1.31
22	Styrene	5.0	100	7.80	1.32
23	Styrene	5.0	100	8.10	1.33
24	Styrene	5.0	100	8.40	1.34
25	Styrene	5.0	100	8.70	1.35
26	Styrene	5.0	100	9.00	1.36
27	Styrene	5.0	100	9.30	1.37
28	Styrene	5.0	100	9.60	1.38
29	Styrene	5.0	100	9.90	1.39
30	Styrene	5.0	100	10.20	1.40

Table II

## TAPE CONTACT DISTANCES (mm) FOR TAPE No. 1

No.	DISTANCE	No.	DISTANCE	No.	DISTANCE	No.	DISTANCE
1	33.8	20	23.7	39	10.0	58	33.8
2	104.0	21	31.2	40	6.0	59	20.2
3	77.0	22	17.3	41	5.6	60	20.8
4	10.0	23	3.0	42	20.2	61	41.0
5	4.9	24	8.0	43	.7	62	8.0
6	8.8	25	2.0	44	16.7	63	5.8
7	17.2	26	9.2	45	5.1	64	4.0
8	19.0	27	5.0	46	77.0	65	10.5
9	155.7	28	6.7	47	5.7	66	61.5
10	72.6	29	59.0	48	29.0	67	4.0
11	15.3	30	18.6	49	3.0	68	4.0
12	9.9	31	5.3	50	3.0	69	16.2
13	4.3	32	5.2	51	4.6	70	8.5
14	2.9	33	5.0	52	4.7	71	5.2
15	8.0	34	38.1	53	34.2	72	4.1
16	2.6	35	42.1	54	39.1	73	11.7
17	3.0	36	8.1	55	17.9	74	3.3
18	1.0	37	6.5	56	11.4	75	12.0
19	24.2	38	4.8	57	5.2		



# TABLE II

MEAN CONTACT DISTANCE (mm) BETWEEN TOOTHED BENT

NO.	DISTANCE	NO.	DISTANCE	NO.	DISTANCE	NO.	DISTANCE
1	0.55	95	1.03	92	0.04	98	0.55
2	0.401	15	0.41	94	0.5	99	0.07
3	0.11	23	0.11	14	0.2	100	0.03
4	0.11	29	0.1	54	0.05	101	0.14
5	0.2	35	0.2	60	1.	102	0.3
6	0.8	38	0.5	64	1.01	103	0.2
7	0.11	45	0.3	72	1.1	104	0.4
8	0.01	51	0.2	74	0.11	105	0.01
9	1.03	58	0.1	75	0.2	106	0.10
10	0.11	63	0.02	80	0.05	107	0.4
11	1.03	70	0.01	84	0.1	108	0.4
12	0.1	71	0.2	90	0.2	109	0.03
13	0.2	78	0.2	91	0.4	110	0.2
14	0.5	82	0.2	92	1.4	111	0.5
15	0.8	83	1.01	93	0.03	112	0.1
16	0.5	87	1.01	94	1.01	113	0.1
17	0.2	90	1.01	95	0.11	114	0.11
18	0.1	93	0.2	96	0.11	115	0.11
19	0.05	94	0.0	97	0.11	116	0.11

Table III

TAPE CONTACT DISTANCES (mm) FOR TAPE No. 2

No.	DISTANCE	No.	DISTANCE	No.	DISTANCE	No.	DISTANCE
1	12.3	26	2.0	51	6.0	76	11.5
2	8.5	27	28.3	52	6.9	77	12.8
3	26.6	28	2.8	53	13.1	78	1.9
4	21.7	29	105.6	54	8.8	79	27.2
5	64.4	30	27.7	55	4.8	80	34.6
6	10.5	31	12.0	56	15.0	81	18.7
7	16.0	32	1.7	57	34.6	82	19.3
8	76.1	33	12.2	58	21.0	83	6.7
9	10.5	34	10.7	59	11.6	84	54.5
10	33.3	35	10.8	60	13.0	85	101.8
11	4.8	36	6.7	61	15.3	86	94.4
12	6.7	37	6.9	62	52.0	87	11.2
13	48.8	38	4.7	63	5.2	88	15.1
14	8.0	39	11.6	64	44.3	89	44.5
15	68.5	40	30.5	65	21.0	90	37.0
16	45.4	41	3.0	66	53.0	91	27.9
17	7.9	42	1.7	67	3.3	92	21.7
18	2.7	43	1.4	68	3.8	93	19.5
19	1.8	44	14.4	69	3.1	94	46.1
20	39.8	45	4.0	70	16.0	95	10.0
21	7.8	46	10.9	71	8.3	96	2.1
22	8.7	47	43.8	72	10.6	97	5.7
23	53.0	48	34.0	73	8.0	98	10.1
24	5.2	49	3.0	74	13.3	99	2.8
25	6.1	50	5.4	75	2.5	100	57.7

Table III

TIME CORRECT DISTANCE (mi) FOR VARIOUS

STATION	NO.	DISTANCE	NO.	DISTANCE	NO.	DISTANCE	NO.
1	1	1.0	21	2.0	31	3.0	41
2	2	2.0	22	3.0	32	4.0	42
3	3	3.0	23	4.0	33	5.0	43
4	4	4.0	24	5.0	34	6.0	44
5	5	5.0	25	6.0	35	7.0	45
6	6	6.0	26	7.0	36	8.0	46
7	7	7.0	27	8.0	37	9.0	47
8	8	8.0	28	9.0	38	10.0	48
9	9	9.0	29	10.0	39	11.0	49
10	10	10.0	30	11.0	40	12.0	50
11	11	11.0	31	12.0	41	13.0	51
12	12	12.0	32	13.0	42	14.0	52
13	13	13.0	33	14.0	43	15.0	53
14	14	14.0	34	15.0	44	16.0	54
15	15	15.0	35	16.0	45	17.0	55
16	16	16.0	36	17.0	46	18.0	56
17	17	17.0	37	18.0	47	19.0	57
18	18	18.0	38	19.0	48	20.0	58
19	19	19.0	39	20.0	49	21.0	59
20	20	20.0	40	21.0	50	22.0	60
21	21	21.0	41	22.0	51	23.0	61
22	22	22.0	42	23.0	52	24.0	62
23	23	23.0	43	24.0	53	25.0	63
24	24	24.0	44	25.0	54	26.0	64
25	25	25.0	45	26.0	55	27.0	65
26	26	26.0	46	27.0	56	28.0	66
27	27	27.0	47	28.0	57	29.0	67
28	28	28.0	48	29.0	58	30.0	68
29	29	29.0	49	30.0	59	31.0	69
30	30	30.0	50	31.0	60	32.0	70
31	31	31.0	51	32.0	61	33.0	71
32	32	32.0	52	33.0	62	34.0	72
33	33	33.0	53	34.0	63	35.0	73
34	34	34.0	54	35.0	64	36.0	74
35	35	35.0	55	36.0	65	37.0	75
36	36	36.0	56	37.0	66	38.0	76
37	37	37.0	57	38.0	67	39.0	77
38	38	38.0	58	39.0	68	40.0	78
39	39	39.0	59	40.0	69	41.0	79
40	40	40.0	60	41.0	70	42.0	80
41	41	41.0	61	42.0	71	43.0	81
42	42	42.0	62	43.0	72	44.0	82
43	43	43.0	63	44.0	73	45.0	83
44	44	44.0	64	45.0	74	46.0	84
45	45	45.0	65	46.0	75	47.0	85
46	46	46.0	66	47.0	76	48.0	86
47	47	47.0	67	48.0	77	49.0	87
48	48	48.0	68	49.0	78	50.0	88
49	49	49.0	69	50.0	79	51.0	89
50	50	50.0	70	51.0	80	52.0	90
51	51	51.0	71	52.0	81	53.0	91
52	52	52.0	72	53.0	82	54.0	92
53	53	53.0	73	54.0	83	55.0	93
54	54	54.0	74	55.0	84	56.0	94
55	55	55.0	75	56.0	85	57.0	95
56	56	56.0	76	57.0	86	58.0	96
57	57	57.0	77	58.0	87	59.0	97
58	58	58.0	78	59.0	88	60.0	98
59	59	59.0	79	60.0	89	61.0	99
60	60	60.0	80	61.0	90	62.0	100

Table III

TAPE CONTACT DISTANCES (mm) FOR TAPE No. 2

No.	DISTANCE	No.	DISTANCE	No.	DISTANCE	No.	DISTANCE
101	2.6	118	52.6	135	4.0	151	4.1
102	19.1	119	12.1	136	53.2	152	8.9
103	104.6	120	55.1	137	6.4	153	1.2
104	86.5	121	15.3	138	21.5	154	6.7
105	110.5	122	72.9	139	3.0	155	5.6
106	7.7	123	36.5	140	6.4	156	14.3
107	54.1	124	2.4	141	9.0	157	2.0
108	157.3	125	7.1	142	3.4	158	6.0
109	116.0	126	6.3	143	14.1	159	10.0
110	10.1	127	5.4	144	8.7	160	4.1
111	23.0	128	31.5	145	3.7	161	4.2
112	5.2	129	7.8	146	5.0	162	3.4
113	39.2	130	31.9	147	14.4	163	8.2
114	46.0	131	5.2	148	20.3	164	4.2
115	30.0	132	11.1	149	17.6	165	2.0
116	12.4	133	11.4	150	3.4	166	4.2
117	47.9	134	9.0				



# Table III

TABLE OF DIRECT DISTANCES (m) FOR THE 100

NO.	DISTANCE	NO.	DISTANCE	NO.	DISTANCE	NO.	DISTANCE
101	1.0	111	1.0	121	1.0	131	1.0
102	1.1	112	1.1	122	1.1	132	1.1
103	1.2	113	1.2	123	1.2	133	1.2
104	1.3	114	1.3	124	1.3	134	1.3
105	1.4	115	1.4	125	1.4	135	1.4
106	1.5	116	1.5	126	1.5	136	1.5
107	1.6	117	1.6	127	1.6	137	1.6
108	1.7	118	1.7	128	1.7	138	1.7
109	1.8	119	1.8	129	1.8	139	1.8
110	1.9	120	1.9	130	1.9	140	1.9
111	2.0	121	2.0	131	2.0	141	2.0
112	2.1	122	2.1	132	2.1	142	2.1
113	2.2	123	2.2	133	2.2	143	2.2
114	2.3	124	2.3	134	2.3	144	2.3
115	2.4	125	2.4	135	2.4	145	2.4
116	2.5	126	2.5	136	2.5	146	2.5
117	2.6	127	2.6	137	2.6	147	2.6
118	2.7	128	2.7	138	2.7	148	2.7
119	2.8	129	2.8	139	2.8	149	2.8
120	2.9	130	2.9	140	2.9	150	2.9
121	3.0	131	3.0	141	3.0	151	3.0
122	3.1	132	3.1	142	3.1	152	3.1
123	3.2	133	3.2	143	3.2	153	3.2
124	3.3	134	3.3	144	3.3	154	3.3
125	3.4	135	3.4	145	3.4	155	3.4
126	3.5	136	3.5	146	3.5	156	3.5
127	3.6	137	3.6	147	3.6	157	3.6
128	3.7	138	3.7	148	3.7	158	3.7
129	3.8	139	3.8	149	3.8	159	3.8
130	3.9	140	3.9	150	3.9	160	3.9
131	4.0	141	4.0	151	4.0	161	4.0
132	4.1	142	4.1	152	4.1	162	4.1
133	4.2	143	4.2	153	4.2	163	4.2
134	4.3	144	4.3	154	4.3	164	4.3
135	4.4	145	4.4	155	4.4	165	4.4
136	4.5	146	4.5	156	4.5	166	4.5
137	4.6	147	4.6	157	4.6	167	4.6
138	4.7	148	4.7	158	4.7	168	4.7
139	4.8	149	4.8	159	4.8	169	4.8
140	4.9	150	4.9	160	4.9	170	4.9
141	5.0	151	5.0	161	5.0	171	5.0
142	5.1	152	5.1	162	5.1	172	5.1
143	5.2	153	5.2	163	5.2	173	5.2
144	5.3	154	5.3	164	5.3	174	5.3
145	5.4	155	5.4	165	5.4	175	5.4
146	5.5	156	5.5	166	5.5	176	5.5
147	5.6	157	5.6	167	5.6	177	5.6
148	5.7	158	5.7	168	5.7	178	5.7
149	5.8	159	5.8	169	5.8	179	5.8
150	5.9	160	5.9	170	5.9	180	5.9

Table IV

TAPE CONTACT DISTANCES (mm) FOR TAPE No. 3

No.	DISTANCE	No.	DISTANCE	No.	DISTANCE	No.	DISTANCE
1	32.1	16	20.5	31	3.8	46	5.2
2	4.3	17	6.0	32	62.7	47	3.9
3	5.4	18	5.5	33	3.4	48	7.4
4	5.5	19	7.0	34	6.1	49	23.0
5	3.6	20	1.5	35	3.9	50	23.2
6	15.1	21	5.2	36	3.9	51	11.7
7	7.3	22	17.1	37	7.8	52	71.2
8	74.9	23	5.6	38	4.3	53	23.6
9	12.0	24	11.5	39	12.4	54	6.2
10	11.1	25	4.0	40	10.9	55	10.4
11	13.2	26	3.9	41	4.8	56	6.8
12	10.1	27	4.8	42	15.3	57	3.2
13	5.8	28	2.9	43	24.0	58	9.6
14	5.9	29	5.9	44	23.5	59	47.1
15	3.6	30	36.6	45	115.1		

TABLE IV

TABLE OF DISTANCES (MILES) FOR TRIP NO. 1

NO.	DISTANCE	NO.	DISTANCE	NO.	DISTANCE	NO.	DISTANCE
1	24.1	11	50.2	21	1.8	31	2.8
2	4.7	12	0.0	22	65.4	32	2.9
3	5.0	13	2.2	23	1.4	33	1.4
4	2.0	14	4.0	24	2.1	34	62.6
5	3.0	15	1.5	25	1.3	35	1.2.5
6	12.1	16	2.3	26	2.8	36	11.4
7	1.2	17	1.1	27	1.2	37	11.1
8	50.1	18	2.4	28	4.3	38	12.6
9	12.0	19	11.2	29	15.0	39	1.8
10	13.1	20	4.0	30	10.3	40	10.4
11	12.3	21	2.3	41	4.2	41	4.4
12	10.1	22	4.4	42	12.2	42	2.5
13	2.8	23	0.0	43	6.0	43	2.0
14	2.3	24	2.4	44	32.3	44	11.1
15	1.0	25	20.0	45	11.1	45	1.0

Table V

TAPE CONTACT DISTANCES (mm) FOR TAPE No. 4

No.	DISTANCE	No.	DISTANCE	No.	DISTANCE	No.	DISTANCE
1	54.3	26	9.2	51	47.2	76	7.9
2	110.2	27	5.2	52	23.5	77	7.6
3	3.5	28	14.3	53	51.0	78	17.8
4	23.0	29	11.6	54	66.1	79	7.5
5	3.1	30	7.4	55	34.7	80	17.5
6	205.0	31	5.9	56	8.8	81	7.7
7	32.0	32	22.3	57	8.2	82	11.6
8	2.0	33	14.1	58	16.3	83	60.1
9	3.0	34	93.5	59	13.1	84	39.6
10	11.0	35	2.4	60	11.0	85	13.4
11	7.0	36	136.0	61	7.9	86	6.1
12	24.3	37	22.9	62	12.3	87	41.4
13	48.4	38	28.3	63	24.6	88	2.0
14	96.5	39	18.0	64	7.3	89	8.7
15	68.3	40	11.9	65	24.0	90	8.1
16	31.7	41	58.7	66	4.3	91	2.1
17	7.4	42	49.3	67	7.0	92	16.2
18	11.3	43	9.0	68	16.2	93	25.7
19	7.0	44	12.5	69	3.9	94	12.6
20	3.8	45	34.6	70	18.0	95	4.1
21	2.5	46	17.4	71	11.8	96	30.0
22	2.0	47	9.8	72	4.0	97	11.0
23	7.6	48	30.3	73	5.8	98	13.0
24	8.3	49	6.8	74	10.2	99	15.5
25	47.0	50	15.3	75	6.2	100	5.5



## TABLE

TABLE CONTAINING THE RESULTS OF THE ANALYSES OF THE

ANALYST	NO.	DATE	NO.	DATE	ANALYST	NO.
1	1	1891	1	1891	1	1
2	2	1891	2	1891	2	2
3	3	1891	3	1891	3	3
4	4	1891	4	1891	4	4
5	5	1891	5	1891	5	5
6	6	1891	6	1891	6	6
7	7	1891	7	1891	7	7
8	8	1891	8	1891	8	8
9	9	1891	9	1891	9	9
10	10	1891	10	1891	10	10
11	11	1891	11	1891	11	11
12	12	1891	12	1891	12	12
13	13	1891	13	1891	13	13
14	14	1891	14	1891	14	14
15	15	1891	15	1891	15	15
16	16	1891	16	1891	16	16
17	17	1891	17	1891	17	17
18	18	1891	18	1891	18	18
19	19	1891	19	1891	19	19
20	20	1891	20	1891	20	20
21	21	1891	21	1891	21	21
22	22	1891	22	1891	22	22
23	23	1891	23	1891	23	23
24	24	1891	24	1891	24	24
25	25	1891	25	1891	25	25
26	26	1891	26	1891	26	26
27	27	1891	27	1891	27	27
28	28	1891	28	1891	28	28
29	29	1891	29	1891	29	29
30	30	1891	30	1891	30	30
31	31	1891	31	1891	31	31
32	32	1891	32	1891	32	32
33	33	1891	33	1891	33	33
34	34	1891	34	1891	34	34
35	35	1891	35	1891	35	35

Table V

TAPE CONTACT DISTANCES (mm) FOR TAPE No. 4

No.	DISTANCE	No.	DISTANCE	No.	DISTANCE	No.	DISTANCE
101	2.6	109	5.5	117	12.3	125	6.5
102	12.6	110	2.3	118	3.5	126	36.0
103	28.9	111	10.7	119	9.0	127	9.0
104	6.1	112	2.2	120	13.9	128	4.8
105	5.0	113	6.5	121	3.2	129	3.2
106	7.0	114	3.1	122	55.9	130	7.8
107	8.9	115	11.0	123	25.4	131	9.6
108	4.6	116	6.0	124	4.0		

Table V

TABLE V. (continued)

Distance	Distance	Distance	Distance	Distance	Distance	Distance
101	102	103	104	105	106	107
108	109	110	111	112	113	114
115	116	117	118	119	120	121
122	123	124	125	126	127	128
129	130	131	132	133	134	135
136	137	138	139	140	141	142
143	144	145	146	147	148	149
150	151	152	153	154	155	156
157	158	159	160	161	162	163
164	165	166	167	168	169	170
171	172	173	174	175	176	177
178	179	180	181	182	183	184
185	186	187	188	189	190	191
192	193	194	195	196	197	198
199	200	201	202	203	204	205
206	207	208	209	210	211	212
213	214	215	216	217	218	219
220	221	222	223	224	225	226
227	228	229	230	231	232	233
234	235	236	237	238	239	240
241	242	243	244	245	246	247
248	249	250	251	252	253	254
255	256	257	258	259	260	261
262	263	264	265	266	267	268
269	270	271	272	273	274	275
276	277	278	279	280	281	282
283	284	285	286	287	288	289
290	291	292	293	294	295	296
297	298	299	300	301	302	303
304	305	306	307	308	309	310
311	312	313	314	315	316	317
318	319	320	321	322	323	324
325	326	327	328	329	330	331
332	333	334	335	336	337	338
339	340	341	342	343	344	345
346	347	348	349	350	351	352
353	354	355	356	357	358	359
360	361	362	363	364	365	366
367	368	369	370	371	372	373
374	375	376	377	378	379	380
381	382	383	384	385	386	387
388	389	390	391	392	393	394
395	396	397	398	399	400	401
402	403	404	405	406	407	408
409	410	411	412	413	414	415
416	417	418	419	420	421	422
423	424	425	426	427	428	429
430	431	432	433	434	435	436
437	438	439	440	441	442	443
444	445	446	447	448	449	450
451	452	453	454	455	456	457
458	459	460	461	462	463	464
465	466	467	468	469	470	471
472	473	474	475	476	477	478
479	480	481	482	483	484	485
486	487	488	489	490	491	492
493	494	495	496	497	498	499
500	501	502	503	504	505	506
507	508	509	510	511	512	513
514	515	516	517	518	519	520
521	522	523	524	525	526	527
528	529	530	531	532	533	534
535	536	537	538	539	540	541
542	543	544	545	546	547	548
549	550	551	552	553	554	555
556	557	558	559	560	561	562
563	564	565	566	567	568	569
570	571	572	573	574	575	576
577	578	579	580	581	582	583
584	585	586	587	588	589	590
591	592	593	594	595	596	597
598	599	600	601	602	603	604
605	606	607	608	609	610	611
612	613	614	615	616	617	618
619	620	621	622	623	624	625
626	627	628	629	630	631	632
633	634	635	636	637	638	639
640	641	642	643	644	645	646
647	648	649	650	651	652	653
654	655	656	657	658	659	660
661	662	663	664	665	666	667
668	669	670	671	672	673	674
675	676	677	678	679	680	681
682	683	684	685	686	687	688
689	690	691	692	693	694	695
696	697	698	699	700	701	702
703	704	705	706	707	708	709
710	711	712	713	714	715	716
717	718	719	720	721	722	723
724	725	726	727	728	729	730
731	732	733	734	735	736	737
738	739	740	741	742	743	744
745	746	747	748	749	750	751
752	753	754	755	756	757	758
759	760	761	762	763	764	765
766	767	768	769	770	771	772
773	774	775	776	777	778	779
780	781	782	783	784	785	786
787	788	789	790	791	792	793
794	795	796	797	798	799	800
801	802	803	804	805	806	807
808	809	810	811	812	813	814
815	816	817	818	819	820	821
822	823	824	825	826	827	828
829	830	831	832	833	834	835
836	837	838	839	840	841	842
843	844	845	846	847	848	849
850	851	852	853	854	855	856
857	858	859	860	861	862	863
864	865	866	867	868	869	870
871	872	873	874	875	876	877
878	879	880	881	882	883	884
885	886	887	888	889	890	891
892	893	894	895	896	897	898
899	900	901	902	903	904	905
906	907	908	909	910	911	912
913	914	915	916	917	918	919
920	921	922	923	924	925	926
927	928	929	930	931	932	933
934	935	936	937	938	939	940
941	942	943	944	945	946	947
948	949	950	951	952	953	954
955	956	957	958	959	960	961
962	963	964	965	966	967	968
969	970	971	972	973	974	975
976	977	978	979	980	981	982
983	984	985	986	987	988	989
990	991	992	993	994	995	996
997	998	999	1000	1001	1002	1003
1004	1005	1006	1007	1008	1009	1010
1011	1012	1013	1014	1015	1016	1017
1018	1019	1020	1021	1022	1023	1024
1025	1026	1027	1028	1029	1030	1031
1032	1033	1034	1035	1036	1037	1038
1039	1040	1041	1042	1043	1044	1045
1046	1047	1048	1049	1050	1051	1052
1053	1054	1055	1056	1057	1058	1059
1060	1061	1062	1063	1064	1065	1066
1067	1068	1069	1070	1071	1072	1073
1074	1075	1076	1077	1078	1079	1080
1081	1082	1083	1084	1085	1086	1087
1088	1089	1090	1091	1092	1093	1094
1095	1096	1097	1098	1099	1100	1101
1102	1103	1104	1105	1106	1107	1108
1109	1110	1111	1112	1113	1114	1115
1116	1117	1118	1119	1120	1121	1122
1123	1124	1125	1126	1127	1128	1129
1130	1131	1132	1133	1134	1135	1136
1137	1138	1139	1140	1141	1142	1143
1144	1145	1146	1147	1148	1149	1150
1151	1152	1153	1154	1155	1156	1157
1158	1159	1160	1161	1162	1163	1164
1165	1166	1167	1168	1169	1170	1171
1172	1173	1174	1175	1176	1177	1178
1179	1180	1181	1182	1183	1184	1185
1186	1187	1188	1189	1190	1191	1192
1193	1194	1195	1196	1197	1198	1199
1200	1201	1202	1203	1204	1205	1206
1207	1208	1209	1210	1211	1212	1213
1214	1215	1216	1217	1218	1219	1220
1221	1222	1223	1224	1225	1226	1227
1228	1229	1230	1231	1232	1233	1234
1235	1236	1237	1238	1239	1240	1241
1242	1243	1244	1245	1246	1247	1248
1249	1250	1251	1252	1253	1254	1255
1256	1257	1258	1259	1260	1261	1262
1263	1264	1265	1266	1267	1268	1269
1270	1271	1272	1273	1274	1275	1276
1277	1278	1279	1280	1281	1282	1283
1284	1285	1286	1287	1288	1289	1290
1291	1292	1293	1294	1295	1296	1297
1298	1299	1300	1301	1302	1303	1304
1305	1306	1307	1308	1309	1310	1311
1312	1313	1314	1315	1316	1317	1318
1319	1320	1321	1322	1323	1324	1325
1326	1327	1328	1329	1330	1331	1332
1333	1334	1335	1336	1337	1338	1339
1340	1341	1342	1343	1344	1345	1346
1347	1348	1349	1350	1351	1352	1353
1354	1355	1356	1357	1358	1359	1360
1361	1362	1363	1364	1365	1366	1367
1368	1369	1370	1371	1372	1373	1374
1375	1376	1377	1378	1379	1380	1381
1382	1383	1384	1385	1386	1387	1388
1389	1390	1391	1392	1393	1394	1395
1396	1397	1398	1399	1400	1401	1402
1403	1404	1405	1406	1407	1408	1409
1410	1411	1412	1413	1414	1415	1416
1417	1418	1419	1420	1421	1422	1423
1424	1425	1426	1427	1428	1429	1430
1431	1432	1433	1434	1435	1436	1437
1438	1439	1440	1441	1442	1443	1444
1445	1446	1447	1448	1449	1450	1451
1452	1453	1454	1455	1456	1457	1458
1459	1460	1461	1462	1463	1464	1465
1466	1467	1468	1469			

Table VI

TAPE CONTACT DISTANCES (mm) FOR TAPE No. 5

No.	DISTANCE	No.	DISTANCE	No.	DISTANCE	No.	DISTANCE
1	3.6	26	10.5	51	4.1	76	8.9
2	5.3	27	2.5	52	7.1	77	8.4
3	7.7	28	4.5	53	6.0	78	9.0
4	18.8	29	11.1	54	.8	79	10.7
5	4.4	30	7.2	55	3.9	80	4.3
6	3.1	31	15.5	56	3.0	81	14.5
7	4.7	32	5.3	57	20.0	82	7.9
8	4.7	33	15.5	58	25.1	83	25.8
9	15.2	34	6.0	59	13.4	84	4.6
10	25.5	35	4.5	60	4.0	85	11.0
11	3.5	36	3.8	61	7.3	86	5.4
12	3.6	37	8.1	62	22.6	87	3.0
13	4.2	38	7.1	63	6.0	88	4.3
14	5.3	39	5.8	64	20.3	89	3.4
15	3.0	40	2.3	65	8.5	90	10.0
16	19.1	41	11.0	66	12.7	91	3.9
17	7.1	42	2.0	67	5.2	92	6.3
18	4.0	43	4.1	68	7.0	93	5.0
19	3.5	44	5.8	69	14.2	94	5.1
20	10.7	45	2.0	70	5.0	95	9.0
21	19.1	46	4.0	71	3.8	96	10.2
22	5.0	47	3.0	72	7.9	97	3.4
23	2.2	48	2.0	73	3.1	98	11.7
24	1.0	49	2.0	74	3.9	99	12.2
25	5.6	50	3.5	75	15.5	100	5.2



Table 1

TABLE 1. SUMMARY OF DATA FOR THE STUDY

STATION	DATE	TIME	WIND	TEMP	HUMID	PRECIP	WAVE	SWELL	SEA
1	10/1	10:00	10	15	65	0.0	2	3	4
2	10/2	11:00	12	16	68	0.0	3	4	5
3	10/3	12:00	15	17	70	0.0	4	5	6
4	10/4	13:00	18	18	72	0.0	5	6	7
5	10/5	14:00	20	19	75	0.0	6	7	8
6	10/6	15:00	22	20	78	0.0	7	8	9
7	10/7	16:00	25	21	80	0.0	8	9	10
8	10/8	17:00	28	22	82	0.0	9	10	11
9	10/9	18:00	30	23	85	0.0	10	11	12
10	10/10	19:00	32	24	88	0.0	11	12	13
11	10/11	20:00	35	25	90	0.0	12	13	14
12	10/12	21:00	38	26	92	0.0	13	14	15
13	10/13	22:00	40	27	95	0.0	14	15	16
14	10/14	23:00	42	28	98	0.0	15	16	17
15	10/15	00:00	45	29	100	0.0	16	17	18
16	10/16	01:00	48	30	102	0.0	17	18	19
17	10/17	02:00	50	31	105	0.0	18	19	20
18	10/18	03:00	52	32	108	0.0	19	20	21
19	10/19	04:00	55	33	110	0.0	20	21	22
20	10/20	05:00	58	34	112	0.0	21	22	23
21	10/21	06:00	60	35	115	0.0	22	23	24
22	10/22	07:00	62	36	118	0.0	23	24	25
23	10/23	08:00	65	37	120	0.0	24	25	26
24	10/24	09:00	68	38	122	0.0	25	26	27
25	10/25	10:00	70	39	125	0.0	26	27	28
26	10/26	11:00	72	40	128	0.0	27	28	29
27	10/27	12:00	75	41	130	0.0	28	29	30
28	10/28	13:00	78	42	132	0.0	29	30	31
29	10/29	14:00	80	43	135	0.0	30	31	32
30	10/30	15:00	82	44	138	0.0	31	32	33
31	10/31	16:00	85	45	140	0.0	32	33	34
32	11/1	17:00	88	46	142	0.0	33	34	35
33	11/2	18:00	90	47	145	0.0	34	35	36
34	11/3	19:00	92	48	148	0.0	35	36	37
35	11/4	20:00	95	49	150	0.0	36	37	38
36	11/5	21:00	98	50	152	0.0	37	38	39
37	11/6	22:00	100	51	155	0.0	38	39	40
38	11/7	23:00	102	52	158	0.0	39	40	41
39	11/8	00:00	105	53	160	0.0	40	41	42
40	11/9	01:00	108	54	162	0.0	41	42	43
41	11/10	02:00	110	55	165	0.0	42	43	44
42	11/11	03:00	112	56	168	0.0	43	44	45
43	11/12	04:00	115	57	170	0.0	44	45	46
44	11/13	05:00	118	58	172	0.0	45	46	47
45	11/14	06:00	120	59	175	0.0	46	47	48
46	11/15	07:00	122	60	178	0.0	47	48	49
47	11/16	08:00	125	61	180	0.0	48	49	50
48	11/17	09:00	128	62	182	0.0	49	50	51
49	11/18	10:00	130	63	185	0.0	50	51	52
50	11/19	11:00	132	64	188	0.0	51	52	53
51	11/20	12:00	135	65	190	0.0	52	53	54
52	11/21	13:00	138	66	192	0.0	53	54	55
53	11/22	14:00	140	67	195	0.0	54	55	56
54	11/23	15:00	142	68	198	0.0	55	56	57
55	11/24	16:00	145	69	200	0.0	56	57	58
56	11/25	17:00	148	70	202	0.0	57	58	59
57	11/26	18:00	150	71	205	0.0	58	59	60
58	11/27	19:00	152	72	208	0.0	59	60	61
59	11/28	20:00	155	73	210	0.0	60	61	62
60	11/29	21:00	158	74	212	0.0	61	62	63
61	11/30	22:00	160	75	215	0.0	62	63	64
62	12/1	23:00	162	76	218	0.0	63	64	65
63	12/2	00:00	165	77	220	0.0	64	65	66
64	12/3	01:00	168	78	222	0.0	65	66	67
65	12/4	02:00	170	79	225	0.0	66	67	68
66	12/5	03:00	172	80	228	0.0	67	68	69
67	12/6	04:00	175	81	230	0.0	68	69	70
68	12/7	05:00	178	82	232	0.0	69	70	71
69	12/8	06:00	180	83	235	0.0	70	71	72
70	12/9	07:00	182	84	238	0.0	71	72	73
71	12/10	08:00	185	85	240	0.0	72	73	74
72	12/11	09:00	188	86	242	0.0	73	74	75
73	12/12	10:00	190	87	245	0.0	74	75	76
74	12/13	11:00	192	88	248	0.0	75	76	77
75	12/14	12:00	195	89	250	0.0	76	77	78
76	12/15	13:00	198	90	252	0.0	77	78	79
77	12/16	14:00	200	91	255	0.0	78	79	80
78	12/17	15:00	202	92	258	0.0	79	80	81
79	12/18	16:00	205	93	260	0.0	80	81	82
80	12/19	17:00	208	94	262	0.0	81	82	83
81	12/20	18:00	210	95	265	0.0	82	83	84
82	12/21	19:00	212	96	268	0.0	83	84	85
83	12/22	20:00	215	97	270	0.0	84	85	86
84	12/23	21:00	218	98	272	0.0	85	86	87
85	12/24	22:00	220	99	275	0.0	86	87	88
86	12/25	23:00	222	100	278	0.0	87	88	89
87	12/26	00:00	225	101	280	0.0	88	89	90
88	12/27	01:00	228	102	282	0.0	89	90	91
89	12/28	02:00	230	103	285	0.0	90	91	92
90	12/29	03:00	232	104	288	0.0	91	92	93
91	12/30	04:00	235	105	290	0.0	92	93	94
92	12/31	05:00	238	106	292	0.0	93	94	95
93	1/1	06:00	240	107	295	0.0	94	95	96
94	1/2	07:00	242	108	298	0.0	95	96	97
95	1/3	08:00	245	109	300	0.0	96	97	98
96	1/4	09:00	248	110	302	0.0	97	98	99
97	1/5	10:00	250	111	305	0.0	98	99	100
98	1/6	11:00	252	112	308	0.0	99	100	101
99	1/7	12:00	255	113	310	0.0	100	101	102
100	1/8	13:00	258	114	312	0.0	101	102	103
101	1/9	14:00	260	115	315	0.0	102	103	104
102	1/10	15:00	262	116	318	0.0	103	104	105
103	1/11	16:00	265	117	320	0.0	104	105	106
104	1/12	17:00	268	118	322	0.0	105	106	107
105	1/13	18:00	270	119	325	0.0	106	107	108
106	1/14	19:00	272	120	328	0.0	107	108	109
107	1/15	20:00	275	121	330	0.0	108	109	110
108	1/16	21:00	278	122	332	0.0	109	110	111
109	1/17	22:00	280	123	335	0.0	110	111	112
110	1/18	23:00	282	124	338	0.0	111	112	113
111	1/19	00:00	285	125	340	0.0	112	113	114
112	1/20	01:00	288	126	342	0.0	113	114	115
113	1/21	02:00	290	127	345	0.0	114	115	116
114	1/22	03:00	292	128	348	0.0	115	116	117
115	1/23	04:00	295	129	350	0.0	116	117	118
116	1/24	05:00	298	130	352	0.0	117	118	119
117	1/25	06:00	300	131	355	0.0	118	119	120
118	1/26	07:00	302	132	358	0.0	119	120	121
119	1/27	08:00	305	133	360	0.0	120	121	122
120	1/28	09:00	308	134	362	0.0	121	122	123
121	1/29	10:00	310	135	365	0.0	122	123	124
122	1/30	11:00	312	136	368	0.0	123	124	125
123	1/31	12:00	315	137	370	0.0	124	125	126
124	2/1	13:00	318	138	372	0.0	125	126	127
125	2/2	14:00	320	139	375	0.0	126	127	128
126	2/3	15:00	322	140	378	0.0	127	128	129
127	2/4	16:00	325	141	380	0.0	128	129	130
128	2/5	17:00	328	142	382	0.0	129	130	131
129	2/6	18:00	330	143	385	0.0	130	131	132
130	2/7	19:00	332	144	388	0.0	131	132	133
131	2/8	20:00	335	145	390	0.0	132	133	134
132	2/9	21:00	338	146	392	0.0	133	134	135
133	2/10	22:00	340	147	395	0.0	134	135	136
134	2/11	23:00	342	148	398	0.0	135	136	137
135	2/12	00:00	345	149	400	0.0	136	137	138
136	2/13	01:00	348	150	402	0.0	137	138	139
137	2/14	02:00	350	151	405	0.0	138	139	140
138	2/15	03:00	352	152	408	0.0	139	140	141
139	2/16	04:00	355	153	410	0.0	140	141	142
140	2/17	05:00	358	154	412	0.0	141	142	143
141	2/18	06:00	360	155	415	0.0	142	143	144
142	2/19	07:00	362	156	418	0.0	143	144	145
143	2/20	08:00							

Table VI

TAPE CONTACT DISTANCES (mm) FOR TAPE No. 5

No.	DISTANCE	No.	DISTANCE	No.	DISTANCE	No.	DISTANCE
101	2.3	126	7.0	151	6.4	176	5.8
102	15.0	127	2.4	152	20.6	177	11.4
103	5.1	128	6.0	153	4.9	178	13.1
104	24.3	129	8.7	154	22.2	179	3.8
105	5.2	130	3.4	155	7.0	180	5.9
106	4.1	131	2.0	156	7.6	181	5.8
107	2.2	132	6.2	157	9.2	182	3.1
108	23.5	133	8.3	158	11.4	183	3.3
109	5.5	134	5.5	159	7.2	184	2.3
110	6.7	135	5.6	160	2.5	185	5.0
111	35.0	136	7.0	161	5.3	186	9.5
112	14.5	137	15.0	162	3.7	187	8.2
113	5.0	138	4.6	163	7.5	188	17.3
114	1.9	139	4.0	164	10.5	189	10.9
115	3.2	140	14.0	165	9.0	190	7.1
116	2.9	141	8.4	166	6.5	191	78.7
117	2.1	142	3.8	167	5.5	192	11.9
118	1.0	143	5.7	168	1.2	193	29.5
119	7.0	144	1.0	169	39.6	194	14.8
120	18.1	145	22.3	170	10.2	195	16.5
121	21.2	146	7.3	171	23.9	196	3.9
122	12.5	147	7.0	172	2.4	197	5.3
123	15.4	148	10.5	173	8.0	198	.8
124	5.8	149	8.5	174	3.2	199	12.2
125	4.0	150	6.5	175	1.0	200	20.8

TABLE VI

THE CONTACT DISTANCES (MILES) FOR EACH NO. 2

NO.	DISTANCE	NO.	DISTANCE	NO.	DISTANCE	NO.	DISTANCE
101	5.2	181	1.0	261	0.4	341	2.0
102	12.0	182	0.4	262	20.0	342	11.4
103	0.1	183	0.0	263	0.3	343	12.1
104	20.2	184	0.7	264	28.5	344	12.0
105	0.5	185	3.0	265	1.0	345	0.0
106	4.1	186	0.0	266	1.0	346	0.0
107	0.0	187	0.0	267	0.0	347	0.0
108	22.2	188	0.2	268	11.4	348	10.2
109	0.2	189	0.2	269	1.5	349	0.2
110	0.7	190	0.0	270	0.2	350	0.0
111	32.0	191	1.0	271	0.2	351	0.0
112	14.2	192	12.0	272	0.0	352	0.0
113	0.0	193	0.0	273	1.0	353	11.3
114	1.0	194	0.0	274	0.0	354	10.0
115	3.5	195	10.0	275	0.0	355	1.0
116	5.0	196	0.0	276	0.0	356	10.0
117	2.1	197	0.2	277	0.0	357	11.0
118	1.0	198	0.0	278	0.0	358	0.0
119	1.0	199	10.0	279	0.0	359	10.0
120	18.1	200	10.0	280	0.0	360	10.0
121	51.0	201	1.0	281	0.0	361	0.0
122	1.0	202	0.0	282	0.0	362	0.0
123	12.0	203	0.0	283	0.0	363	0.0
124	0.0	204	0.0	284	0.0	364	0.0
125	0.0	205	0.0	285	0.0	365	0.0
126	0.0	206	0.0	286	0.0	366	0.0
127	0.0	207	0.0	287	0.0	367	0.0
128	0.0	208	0.0	288	0.0	368	0.0
129	0.0	209	0.0	289	0.0	369	0.0
130	0.0	210	0.0	290	0.0	370	0.0
131	0.0	211	0.0	291	0.0	371	0.0
132	0.0	212	0.0	292	0.0	372	0.0
133	0.0	213	0.0	293	0.0	373	0.0
134	0.0	214	0.0	294	0.0	374	0.0
135	0.0	215	0.0	295	0.0	375	0.0
136	0.0	216	0.0	296	0.0	376	0.0
137	0.0	217	0.0	297	0.0	377	0.0
138	0.0	218	0.0	298	0.0	378	0.0
139	0.0	219	0.0	299	0.0	379	0.0
140	0.0	220	0.0	300	0.0	380	0.0

Table VI

TAPE CONTACT DISTANCES (mm) FOR TAPE No. 5

No.	DISTANCE	No.	DISTANCE	No.	DISTANCE	No.	DISTANCE
201	14.0	216	19.1	231	10.0	246	5.6
202	22.2	217	5.1	232	23.9	247	10.7
203	2.3	218	4.4	233	3.9	248	13.7
204	15.8	219	10.5	234	12.0	249	8.6
205	5.8	220	24.3	235	15.9	250	144.7
206	5.4	221	4.3	236	5.1	251	10.0
207	2.8	222	5.6	237	6.0	252	10.9
208	2.2	223	3.1	238	2.7	253	9.7
209	3.6	224	27.2	239	4.0	254	7.2
210	9.0	225	8.3	240	26.0	255	8.9
211	4.0	226	9.3	241	40.3	256	8.7
212	5.3	227	20.6	242	8.7	257	2.0
213	3.8	228	2.0	243	10.3	258	4.6
214	5.6	229	2.5	244	3.3	259	4.6
215	4.0	230	4.0	245	9.6	260	34.0



TABLE I

THE EFFECT OF TEMPERATURE ON THE RATE OF

NO.	TEMPERATURE	NO.	TEMPERATURE	NO.	TEMPERATURE	NO.	TEMPERATURE
101	10.0	102	10.0	103	10.0	104	10.0
105	10.0	106	10.0	107	10.0	108	10.0
109	10.0	110	10.0	111	10.0	112	10.0
113	10.0	114	10.0	115	10.0	116	10.0
117	10.0	118	10.0	119	10.0	120	10.0
121	10.0	122	10.0	123	10.0	124	10.0
125	10.0	126	10.0	127	10.0	128	10.0
129	10.0	130	10.0	131	10.0	132	10.0
133	10.0	134	10.0	135	10.0	136	10.0
137	10.0	138	10.0	139	10.0	140	10.0
141	10.0	142	10.0	143	10.0	144	10.0
145	10.0	146	10.0	147	10.0	148	10.0
149	10.0	150	10.0	151	10.0	152	10.0
153	10.0	154	10.0	155	10.0	156	10.0
157	10.0	158	10.0	159	10.0	160	10.0
161	10.0	162	10.0	163	10.0	164	10.0
165	10.0	166	10.0	167	10.0	168	10.0
169	10.0	170	10.0	171	10.0	172	10.0
173	10.0	174	10.0	175	10.0	176	10.0
177	10.0	178	10.0	179	10.0	180	10.0
181	10.0	182	10.0	183	10.0	184	10.0
185	10.0	186	10.0	187	10.0	188	10.0
189	10.0	190	10.0	191	10.0	192	10.0
193	10.0	194	10.0	195	10.0	196	10.0
197	10.0	198	10.0	199	10.0	200	10.0

Table VII

TAPE CONTACT DISTANCES (mm) FOR TAPE No. 6

No.	DISTANCE	No.	DISTANCE	No.	DISTANCE	No.	DISTANCE
1	118.5	26	8.5	51	5.0	76	12.2
2	14.9	27	1.0	52	17.7	77	14.8
3	7.0	28	5.1	53	5.3	78	20.4
4	15.7	29	5.9	54	5.0	79	38.6
5	22.2	30	3.6	55	11.9	80	2.6
6	3.6	31	4.1	56	9.7	81	10.8
7	23.5	32	5.0	57	3.8	82	15.0
8	15.1	33	5.6	58	10.0	83	5.7
9	10.0	34	34.0	59	10.1	84	39.8
10	25.6	35	12.7	60	8.3	85	5.9
11	28.8	36	9.0	61	5.6	86	2.6
12	21.0	37	14.0	62	12.0	87	1.8
13	24.0	38	12.1	63	2.0	88	1.5
14	8.5	39	7.1	64	3.1	89	7.0
15	2.2	40	31.1	65	2.1	90	2.8
16	3.7	41	5.4	66	3.8	91	2.4
17	7.2	42	10.6	67	7.1	92	12.0
18	5.6	43	8.1	68	9.5	93	14.7
19	5.5	44	3.7	69	3.9	94	3.6
20	8.0	45	3.0	70	3.7	95	8.6
21	7.6	46	49.1	71	5.0	96	1.7
22	7.2	47	3.8	72	23.6	97	7.2
23	5.6	48	5.5	73	10.1	98	2.7
24	8.0	49	3.7	74	22.5	99	10.2
25	4.0	50	3.6	75	18.6	100	5.0



Table VII

TAPE CONTACT DISTANCES (mm) FOR TAPE No. 6

No.	DISTANCE	No.	DISTANCE	No.	DISTANCE	No.	DISTANCE
101	49.1	120	45.8	139	5.9	158	10.8
102	10.5	121	17.2	140	2.9	159	5.0
103	15.1	122	4.6	141	7.0	160	9.8
104	26.6	123	10.0	142	4.5	161	3.2
105	4.6	124	1.1	143	4.0	162	4.8
106	13.0	125	9.8	144	16.2	163	3.5
107	4.1	126	12.0	145	12.5	164	1.2
108	3.0	127	5.5	146	12.0	165	2.2
109	2.0	128	11.2	147	4.0	166	3.2
110	6.9	129	2.6	148	5.2	167	2.4
111	4.0	130	1.0	149	11.5	168	3.3
112	8.1	131	6.7	150	6.0	169	11.8
113	1.8	132	5.3	151	5.3	170	7.8
114	24.1	133	4.6	152	2.8	171	4.7
115	30.5	134	5.1	153	3.9	172	36.0
116	4.2	135	32.3	154	23.0	173	41.0
117	4.1	136	5.9	155	27.0	174	7.5
118	4.1	137	9.0	156	12.8	175	2.5
119	17.3	138	12.1	157	20.0		



TABLE 11

NO.	DISTANCE	NO.	DISTANCE	NO.	DISTANCE	NO.	DISTANCE
101	10.1	139	10.8	177	11.5	215	12.2
102	10.2	140	11.0	178	11.7	216	12.4
103	10.3	141	11.2	179	11.9	217	12.6
104	10.4	142	11.4	180	12.1	218	12.8
105	10.5	143	11.6	181	12.3	219	13.0
106	10.6	144	11.8	182	12.5	220	13.2
107	10.7	145	12.0	183	12.7	221	13.4
108	10.8	146	12.2	184	12.9	222	13.6
109	10.9	147	12.4	185	13.1	223	13.8
110	11.0	148	12.6	186	13.3	224	14.0
111	11.1	149	12.8	187	13.5	225	14.2
112	11.2	150	13.0	188	13.7	226	14.4
113	11.3	151	13.2	189	13.9	227	14.6
114	11.4	152	13.4	190	14.1	228	14.8
115	11.5	153	13.6	191	14.3	229	15.0
116	11.6	154	13.8	192	14.5	230	15.2
117	11.7	155	14.0	193	14.7	231	15.4
118	11.8	156	14.2	194	14.9	232	15.6
119	11.9	157	14.4	195	15.1	233	15.8
120	12.0	158	14.6	196	15.3	234	16.0
121	12.1	159	14.8	197	15.5	235	16.2
122	12.2	160	15.0	198	15.7	236	16.4
123	12.3	161	15.2	199	15.9	237	16.6
124	12.4	162	15.4	200	16.1	238	16.8
125	12.5	163	15.6	201	16.3	239	17.0
126	12.6	164	15.8	202	16.5	240	17.2
127	12.7	165	16.0	203	16.7	241	17.4
128	12.8	166	16.2	204	16.9	242	17.6
129	12.9	167	16.4	205	17.1	243	17.8
130	13.0	168	16.6	206	17.3	244	18.0
131	13.1	169	16.8	207	17.5	245	18.2
132	13.2	170	17.0	208	17.7	246	18.4
133	13.3	171	17.2	209	17.9	247	18.6
134	13.4	172	17.4	210	18.1	248	18.8
135	13.5	173	17.6	211	18.3	249	19.0
136	13.6	174	17.8	212	18.5	250	19.2
137	13.7	175	18.0	213	18.7	251	19.4
138	13.8	176	18.2	214	18.9	252	19.6
139	13.9	177	18.4	215	19.1	253	19.8
140	14.0	178	18.6	216	19.3	254	20.0
141	14.1	179	18.8	217	19.5	255	20.2
142	14.2	180	19.0	218	19.7	256	20.4
143	14.3	181	19.2	219	19.9	257	20.6
144	14.4	182	19.4	220	20.1	258	20.8
145	14.5	183	19.6	221	20.3	259	21.0
146	14.6	184	19.8	222	20.5	260	21.2
147	14.7	185	20.0	223	20.7	261	21.4
148	14.8	186	20.2	224	20.9	262	21.6
149	14.9	187	20.4	225	21.1	263	21.8
150	15.0	188	20.6	226	21.3	264	22.0
151	15.1	189	20.8	227	21.5	265	22.2
152	15.2	190	21.0	228	21.7	266	22.4
153	15.3	191	21.2	229	21.9	267	22.6
154	15.4	192	21.4	230	22.1	268	22.8
155	15.5	193	21.6	231	22.3	269	23.0
156	15.6	194	21.8	232	22.5	270	23.2
157	15.7	195	22.0	233	22.7	271	23.4
158	15.8	196	22.2	234	22.9	272	23.6
159	15.9	197	22.4	235	23.1	273	23.8
160	16.0	198	22.6	236	23.3	274	24.0
161	16.1	199	22.8	237	23.5	275	24.2
162	16.2	200	23.0	238	23.7	276	24.4
163	16.3	201	23.2	239	23.9	277	24.6
164	16.4	202	23.4	240	24.1	278	24.8
165	16.5	203	23.6	241	24.3	279	25.0
166	16.6	204	23.8	242	24.5	280	25.2
167	16.7	205	24.0	243	24.7	281	25.4
168	16.8	206	24.2	244	24.9	282	25.6
169	16.9	207	24.4	245	25.1	283	25.8
170	17.0	208	24.6	246	25.3	284	26.0
171	17.1	209	24.8	247	25.5	285	26.2
172	17.2	210	25.0	248	25.7	286	26.4
173	17.3	211	25.2	249	25.9	287	26.6
174	17.4	212	25.4	250	26.1	288	26.8
175	17.5	213	25.6	251	26.3	289	27.0
176	17.6	214	25.8	252	26.5	290	27.2
177	17.7	215	26.0	253	26.7	291	27.4
178	17.8	216	26.2	254	26.9	292	27.6
179	17.9	217	26.4	255	27.1	293	27.8
180	18.0	218	26.6	256	27.3	294	28.0
181	18.1	219	26.8	257	27.5	295	28.2
182	18.2	220	27.0	258	27.7	296	28.4
183	18.3	221	27.2	259	27.9	297	28.6
184	18.4	222	27.4	260	28.1	298	28.8
185	18.5	223	27.6	261	28.3	299	29.0
186	18.6	224	27.8	262	28.5	300	29.2
187	18.7	225	28.0	263	28.7	301	29.4
188	18.8	226	28.2	264	28.9	302	29.6
189	18.9	227	28.4	265	29.1	303	29.8
190	19.0	228	28.6	266	29.3	304	30.0
191	19.1	229	28.8	267	29.5	305	30.2
192	19.2	230	29.0	268	29.7	306	30.4
193	19.3	231	29.2	269	29.9	307	30.6
194	19.4	232	29.4	270	30.1	308	30.8
195	19.5	233	29.6	271	30.3	309	31.0
196	19.6	234	29.8	272	30.5	310	31.2
197	19.7	235	30.0	273	30.7	311	31.4
198	19.8	236	30.2	274	30.9	312	31.6
199	19.9	237	30.4	275	31.1	313	31.8
200	20.0	238	30.6	276	31.3	314	32.0
201	20.1	239	30.8	277	31.5	315	32.2
202	20.2	240	31.0	278	31.7	316	32.4
203	20.3	241	31.2	279	31.9	317	32.6
204	20.4	242	31.4	280	32.1	318	32.8
205	20.5	243	31.6	281	32.3	319	33.0
206	20.6	244	31.8	282	32.5	320	33.2
207	20.7	245	32.0	283	32.7	321	33.4
208	20.8	246	32.2	284	32.9	322	33.6
209	20.9	247	32.4	285	33.1	323	33.8
210	21.0	248	32.6	286	33.3	324	34.0
211	21.1	249	32.8	287	33.5	325	34.2
212	21.2	250	33.0	288	33.7	326	34.4
213	21.3	251	33.2	289	33.9	327	34.6
214	21.4	252	33.4	290	34.1	328	34.8
215	21.5	253	33.6	291	34.3	329	35.0
216	21.6	254	33.8	292	34.5	330	35.2
217	21.7	255	34.0	293	34.7	331	35.4
218	21.8	256	34.2	294	34.9	332	35.6
219	21.9	257	34.4	295	35.1	333	35.8
220	22.0	258	34.6	296	35.3	334	36.0
221	22.1	259	34.8	297	35.5	335	36.2
222	22.2	260	35.0	298	35.7	336	36.4
223	22.3	261	35.2	299	35.9	337	36.6
224	22.4	262	35.4	300	36.1	338	36.8
225	22.5	263	35.6	301	36.3	339	37.0
226	22.6	264	35.8	302	36.5	340	37.2
227	22.7	265	36.0	303	36.7	341	37.4
228	22.8	266	36.2	304	36.9	342	37.6
229	22.9	267	36.4	305	37.1	343	37.8
230	23.0	268	36.6	306	37.3	344	38.0
231	23.1	269	36.8	307	37.5	345	38.2
232	23.2	270	37.0	308	37.7	346	38.4
233	23.3	271	37.2	309	37.9	347	38.6
234	23.4	272	37.4	310	38.1	348	38.8
235	23.5	273	37.6	311	38.3	349	39.0
236	23.6	274	37.8	312	38.5	350	39.2
237	23.7	275	38.0	313	38.7	351	39.4
238	23.8	276	38.2	314	38.9	352	39.6
239	23.9	277	38.4	315	39.1	353	39.8
240	24.0	278	38.6	316	39.3	354	40.0
241	24.1	279	38.8	317	39.5	355	40.2
242	24.2	280	39.0	318	39.7	356	40.4
243	24.3	281	39.2	319	39.9	357	40.6
244	24.4	282	39.4	320	40.1	358	40.8
245	24.5	283	39.6	321	40.3	359	41.0
246	24.6	284	39.8	322	40.5	360	41.2
247	24.7	285	40.0	323	40.7	361	41.4
248	24.8	286	40.2	324	40.9	362	41.6
249	24.9	287	40.4	325	41.1	363	41.8
250	25.0	288	40.6	326	41.3	364	42.0
251	25.1	289	40.8	327	41.5	365	42.2
252	25.2	290	41.0	328	41.7	366	42.4
253	25.3	291	41.2	329	41.9	367	42.6
254	25.4	292	41.4	330	42.1	368	42.8
255	25.5	293	41.6	331	42.3	369	43.0
256	25.6	294	41.8	332	42.5	370	43.2
257	25.7	295	42.0	333	42.7	371	43.4
258	25.8	296	42.2	334	42.9	372	43.6
259	25.9	297	42.4	335	43.1	373	43.8
260	26.0	298	42.6	336	43.3	374	44.0
261	26.1	299	42.8	337	43.5	375	44.2
262	26.2	300	43.0	338	43.7	376	44.4
263	26.3	301	43.2	339	43.9	377	44.6
264	26.4	302	43.4	340	44.1	378	44.8
265	26.5	303	43.6	341	44.3	379	45.0
266	26.6	304	43.8	342			

Table VIII

TAPE CONTACT DISTANCE (mm) FOR TAPE No. 7

No.	DISTANCE	No.	DISTANCE	No.	DISTANCE	No.	DISTANCE
1	37.0	26	8.3	51	1.7	76	6.6
2	4.0	27	10.6	52	39.6	77	39.7
3	4.0	28	6.0	53	11.4	78	16.0
4	10.8	29	3.7	54	17.0	79	12.1
5	4.1	30	46.0	55	45.5	80	8.7
6	12.0	31	5.8	56	11.2	81	3.3
7	5.8	32	10.0	57	12.2	82	9.2
8	10.0	33	6.0	58	1.7	83	4.0
9	17.1	34	22.1	59	6.8	84	3.5
10	48.8	35	3.7	60	11.6	85	73.4
11	26.9	36	8.4	61	6.7	86	8.7
12	6.0	37	1.5	62	4.0	87	5.7
13	5.2	38	50.8	63	6.2	88	5.1
14	20.7	39	5.2	64	19.3	89	24.5
15	11.2	40	3.2	65	5.0	90	61.3
16	50.0	41	1.7	66	8.8	91	50.9
17	12.6	42	16.8	67	8.0	92	15.2
18	11.9	43	3.3	68	4.0	93	4.8
19	4.6	44	4.1	69	7.8	94	11.7
20	15.7	45	1.2	70	1.6	95	12.5
21	66.0	46	29.7	71	4.2	96	7.8
22	6.2	47	22.0	72	3.4	97	2.0
23	4.1	48	2.9	73	8.7	98	21.4
24	1.3	49	1.6	74	2.0	99	15.0
25	4.8	50	2.0	75	11.2	100	23.3

Table VIII

TAKE COUNTY HIGHWAYS (and) FOR TAKE NO. 1

NO. 1	TAKE NO. 1	NO. 2	TAKE NO. 2	NO. 3	TAKE NO. 3	NO. 4	TAKE NO. 4
1	1.0	20	1.1	30	1.2	40	1.3
2	1.1	21	1.2	31	1.3	41	1.4
3	1.2	22	1.3	32	1.4	42	1.5
4	1.3	23	1.4	33	1.5	43	1.6
5	1.4	24	1.5	34	1.6	44	1.7
6	1.5	25	1.6	35	1.7	45	1.8
7	1.6	26	1.7	36	1.8	46	1.9
8	1.7	27	1.8	37	1.9	47	2.0
9	1.8	28	1.9	38	2.0	48	2.1
10	1.9	29	2.0	39	2.1	49	2.2
11	2.0	30	2.1	40	2.2	50	2.3
12	2.1	31	2.2	41	2.3	51	2.4
13	2.2	32	2.3	42	2.4	52	2.5
14	2.3	33	2.4	43	2.5	53	2.6
15	2.4	34	2.5	44	2.6	54	2.7
16	2.5	35	2.6	45	2.7	55	2.8
17	2.6	36	2.7	46	2.8	56	2.9
18	2.7	37	2.8	47	2.9	57	3.0
19	2.8	38	2.9	48	3.0	58	3.1
20	2.9	39	3.0	49	3.1	59	3.2
21	3.0	40	3.1	50	3.2	60	3.3
22	3.1	41	3.2	51	3.3	61	3.4
23	3.2	42	3.3	52	3.4	62	3.5
24	3.3	43	3.4	53	3.5	63	3.6
25	3.4	44	3.5	54	3.6	64	3.7
26	3.5	45	3.6	55	3.7	65	3.8
27	3.6	46	3.7	56	3.8	66	3.9
28	3.7	47	3.8	57	3.9	67	4.0
29	3.8	48	3.9	58	4.0	68	4.1
30	3.9	49	4.0	59	4.1	69	4.2
31	4.0	50	4.1	60	4.2	70	4.3
32	4.1	51	4.2	61	4.3	71	4.4
33	4.2	52	4.3	62	4.4	72	4.5
34	4.3	53	4.4	63	4.5	73	4.6
35	4.4	54	4.5	64	4.6	74	4.7
36	4.5	55	4.6	65	4.7	75	4.8
37	4.6	56	4.7	66	4.8	76	4.9
38	4.7	57	4.8	67	4.9	77	5.0
39	4.8	58	4.9	68	5.0	78	5.1
40	4.9	59	5.0	69	5.1	79	5.2
41	5.0	60	5.1	70	5.2	80	5.3
42	5.1	61	5.2	71	5.3	81	5.4
43	5.2	62	5.3	72	5.4	82	5.5
44	5.3	63	5.4	73	5.5	83	5.6
45	5.4	64	5.5	74	5.6	84	5.7
46	5.5	65	5.6	75	5.7	85	5.8
47	5.6	66	5.7	76	5.8	86	5.9
48	5.7	67	5.8	77	5.9	87	6.0
49	5.8	68	5.9	78	6.0	88	6.1
50	5.9	69	6.0	79	6.1	89	6.2
51	6.0	70	6.1	80	6.2	90	6.3
52	6.1	71	6.2	81	6.3	91	6.4
53	6.2	72	6.3	82	6.4	92	6.5
54	6.3	73	6.4	83	6.5	93	6.6
55	6.4	74	6.5	84	6.6	94	6.7
56	6.5	75	6.6	85	6.7	95	6.8
57	6.6	76	6.7	86	6.8	96	6.9
58	6.7	77	6.8	87	6.9	97	7.0
59	6.8	78	6.9	88	7.0	98	7.1
60	6.9	79	7.0	89	7.1	99	7.2
61	7.0	80	7.1	90	7.2	100	7.3

Table VIII

TAPE CONTACT DISTANCES (mm) FOR TAPE No. 7

No.	DISTANCE	No.	DISTANCE	No.	DISTANCE	No.	DISTANCE
101	41.7	106	4.1	111	11.0	116	5.8
102	2.0	107	10.4	112	2.0	117	4.1
103	8.6	108	5.6	113	61.8	118	19.0
104	7.0	109	29.7	114	4.6	119	4.9
105	4.9	110	8.3	115	13.6	120	8.0



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TABLE 1. MEAN VALUES OF THE MEASUREMENTS OF THE STUDY GROUPS. Values are given as mean  $\pm$  SD. \*Significantly different from the control group.[illegible]

Table IX

TAPE CONTACT DISTANCES (mm) FOR TAPE No. 8

No.	DISTANCE	No.	DISTANCE	No.	DISTANCE	No.	DISTANCE
1	3.7	26	1.0	51	4.2	76	4.2
2	3.0	27	.5	52	4.7	77	1.8
3	1.7	28	1.7	53	1.1	78	1.1
4	6.2	29	6.4	54	2.0	79	5.0
5	28.0	30	2.5	55	23.0	80	2.0
6	10.0	31	4.1	56	12.9	81	4.2
7	1.0	32	1.8	57	11.0	82	3.0
8	1.2	33	20.0	58	10.0	83	5.8
9	2.3	34	22.0	59	10.3	84	2.7
10	4.7	35	1.0	60	5.0	85	11.0
11	21.9	36	41.0	61	3.9	86	37.7
12	2.3	37	2.6	62	.5	87	55.2
13	3.1	38	37.0	63	6.1	88	2.8
14	5.1	39	7.0	64	3.8	89	46.9
15	4.0	40	24.5	65	9.0	90	17.0
16	1.8	41	2.5	66	13.8	91	38.3
17	3.9	42	27.5	67	19.9	92	81.4
18	7.2	43	2.0	68	30.0	93	2.3
19	12.2	44	6.8	69	25.0	94	14.9
20	2.0	45	2.8	70	2.8	95	3.0
21	4.5	46	.8	71	72.2	96	3.0
22	13.1	47	15.7	72	7.0	97	2.7
23	2.3	48	4.8	73	6.0	98	60.0
24	.8	49	1.3	74	6.4	99	34.3
25	1.2	50	1.1	75	5.0	100	21.8

# Table 12

LINE CONTACT DISTANCES (M) FOR JUNE NO. 2

NO.	DISTANCE	NO.	DISTANCE	NO.	DISTANCE	NO.	DISTANCE
1	2.1	20	1.0	39	4.5	58	1.1
2	3.0	21	2.0	40	4.0	59	1.1
3	1.5	22	1.1	41	4.0	60	1.1
4	6.2	23	4.0	42	4.0	61	1.1
5	20.0	24	2.2	43	4.0	62	1.1
6	10.0	25	4.1	44	4.0	63	1.1
7	1.0	26	1.0	45	4.0	64	1.1
8	1.5	27	30.0	46	4.0	65	1.1
9	5.0	28	35.0	47	4.0	66	1.1
10	4.1	29	1.0	48	4.0	67	1.1
11	21.2	30	41.0	49	4.0	68	1.1
12	5.2	31	5.0	50	4.0	69	1.1
13	1.1	32	21.0	51	4.0	70	1.1
14	2.1	33	1.0	52	4.0	71	1.1
15	4.0	34	4.2	53	4.0	72	1.1
16	1.0	35	1.2	54	4.0	73	1.1
17	1.0	36	2.0	55	4.0	74	1.1
18	1.0	37	1.2	56	4.0	75	1.1
19	1.0	38	5.1	57	4.0	76	1.1
20	1.0	39	5.0	58	4.0	77	1.1
21	1.0	40	2.0	59	4.0	78	1.1
22	1.0	41	2.0	60	4.0	79	1.1
23	1.0	42	2.0	61	4.0	80	1.1
24	1.0	43	2.0	62	4.0	81	1.1
25	1.0	44	2.0	63	4.0	82	1.1
26	1.0	45	2.0	64	4.0	83	1.1
27	1.0	46	2.0	65	4.0	84	1.1
28	1.0	47	2.0	66	4.0	85	1.1
29	1.0	48	2.0	67	4.0	86	1.1
30	1.0	49	2.0	68	4.0	87	1.1
31	1.0	50	2.0	69	4.0	88	1.1
32	1.0	51	2.0	70	4.0	89	1.1
33	1.0	52	2.0	71	4.0	90	1.1
34	1.0	53	2.0	72	4.0	91	1.1
35	1.0	54	2.0	73	4.0	92	1.1
36	1.0	55	2.0	74	4.0	93	1.1
37	1.0	56	2.0	75	4.0	94	1.1
38	1.0	57	2.0	76	4.0	95	1.1
39	1.0	58	2.0	77	4.0	96	1.1
40	1.0	59	2.0	78	4.0	97	1.1
41	1.0	60	2.0	79	4.0	98	1.1
42	1.0	61	2.0	80	4.0	99	1.1
43	1.0	62	2.0	81	4.0	100	1.1

Table IX

TAPE CONTACT DISTANCES (mm) FOR TAPE No. 8

No.	DISTANCE	No.	DISTANCE	No.	DISTANCE	No.	DISTANCE
101	20.1	126	8.0	151	7.1	176	16.0
102	6.6	127	14.0	152	10.5	177	.8
103	3.8	128	4.2	153	15.8	178	31.5
104	4.0	129	1.9	154	15.3	179	15.1
105	12.2	130	5.6	155	18.5	180	2.3
106	1.8	131	12.7	156	8.0	181	14.7
107	16.0	132	.8	157	3.5	182	8.0
108	13.2	133	5.2	158	2.1	183	17.5
109	12.0	134	1.1	159	1.8	184	3.0
110	4.5	135	1.6	160	29.4	185	3.7
111	6.0	136	5.9	161	2.4	186	18.8
112	2.8	137	5.8	162	2.6	187	9.0
113	1.5	138	13.2	163	42.1	188	2.3
114	13.0	139	6.0	164	16.9	189	1.0
115	16.6	140	5.9	165	2.3	190	4.0
116	5.0	141	39.0	166	22.8	191	.5
117	15.8	142	8.0	167	2.7	192	41.5
118	2.5	143	7.0	168	5.5	193	25.5
119	5.5	144	1.3	169	2.5	194	7.2
120	39.2	145	1.1	170	2.0	195	13.6
121	15.0	146	28.3	171	3.5	196	6.5
122	5.9	147	1.1	172	4.0	197	2.8
123	20.5	148	.9	173	1.9	198	15.8
124	1.7	149	25.8	174	3.3	199	11.0
125	5.6	150	5.7	175	1.0	200	7.2



Table 17

Approximate percentage of water in soil (mm)

Moisture	Moisture	Moisture	Moisture	Moisture	Moisture	Moisture
101	100	100	100	100	100	100
102	100	100	100	100	100	100
103	100	100	100	100	100	100
104	100	100	100	100	100	100
105	100	100	100	100	100	100
106	100	100	100	100	100	100
107	100	100	100	100	100	100
108	100	100	100	100	100	100
109	100	100	100	100	100	100
110	100	100	100	100	100	100
111	100	100	100	100	100	100
112	100	100	100	100	100	100
113	100	100	100	100	100	100
114	100	100	100	100	100	100
115	100	100	100	100	100	100
116	100	100	100	100	100	100
117	100	100	100	100	100	100
118	100	100	100	100	100	100
119	100	100	100	100	100	100
120	100	100	100	100	100	100
121	100	100	100	100	100	100
122	100	100	100	100	100	100
123	100	100	100	100	100	100
124	100	100	100	100	100	100
125	100	100	100	100	100	100
126	100	100	100	100	100	100
127	100	100	100	100	100	100
128	100	100	100	100	100	100
129	100	100	100	100	100	100
130	100	100	100	100	100	100

Table IX

TAPE CONTACT DISTANCES (mm) FOR TAPE No. 8

No.	DISTANCE	No.	DISTANCE	No.	DISTANCE	No.	DISTANCE
201	7.0	226	43.0	251	1.2	276	11.7
202	8.1	227	5.1	252	.7	277	4.0
203	47.8	228	15.3	253	1.1	278	18.7
204	1.3	229	2.2	254	17.5	279	2.0
205	2.2	230	1.1	255	1.9	280	11.7
206	1.0	231	5.1	256	.7	281	2.4
207	7.2	232	1.5	257	44.2	282	3.5
208	2.9	233	1.0	258	14.9	283	1.3
209	7.5	234	28.8	259	7.1	284	1.3
210	5.2	235	2.1	260	3.2	285	1.5
211	5.8	236	6.3	261	.8	286	1.0
212	1.7	237	1.3	262	5.0	287	2.4
213	3.5	238	2.2	263	5.6	288	1.5
214	10.8	239	2.1	264	4.8	289	1.1
215	14.2	240	3.3	265	6.0	290	11.6
216	1.0	241	8.5	266	10.1	291	1.7
217	6.9	242	1.2	267	1.5	292	6.2
218	17.5	243	32.7	268	3.7	293	3.0
219	1.0	244	3.7	269	1.3	294	1.4
220	1.8	245	3.0	270	2.0	295	5.0
221	2.0	246	.6	271	8.0	296	4.0
222	1.3	247	1.5	272	5.6	297	3.0
223	1.0	248	3.0	273	10.0	298	2.0
224	1.5	249	2.9	274	3.1	299	2.3
225	24.1	250	1.5	275	6.0	300	2.2

TABLE 1

MEAN DISTANCE (m) FOR EACH NO. 2

NO.	DISTANCE	NO.	DISTANCE	NO.	DISTANCE	NO.	DISTANCE
101	1.0	201	0.3	301	1.0	401	1.0
102	1.1	202	0.3	302	1.0	402	1.0
103	1.1	203	0.3	303	1.0	403	1.0
104	1.1	204	0.3	304	1.0	404	1.0
105	1.1	205	0.3	305	1.0	405	1.0
106	1.1	206	0.3	306	1.0	406	1.0
107	1.1	207	0.3	307	1.0	407	1.0
108	1.1	208	0.3	308	1.0	408	1.0
109	1.1	209	0.3	309	1.0	409	1.0
110	1.1	210	0.3	310	1.0	410	1.0
111	1.1	211	0.3	311	1.0	411	1.0
112	1.1	212	0.3	312	1.0	412	1.0
113	1.1	213	0.3	313	1.0	413	1.0
114	1.1	214	0.3	314	1.0	414	1.0
115	1.1	215	0.3	315	1.0	415	1.0
116	1.1	216	0.3	316	1.0	416	1.0
117	1.1	217	0.3	317	1.0	417	1.0
118	1.1	218	0.3	318	1.0	418	1.0
119	1.1	219	0.3	319	1.0	419	1.0
120	1.1	220	0.3	320	1.0	420	1.0
121	1.1	221	0.3	321	1.0	421	1.0
122	1.1	222	0.3	322	1.0	422	1.0
123	1.1	223	0.3	323	1.0	423	1.0
124	1.1	224	0.3	324	1.0	424	1.0
125	1.1	225	0.3	325	1.0	425	1.0
126	1.1	226	0.3	326	1.0	426	1.0
127	1.1	227	0.3	327	1.0	427	1.0
128	1.1	228	0.3	328	1.0	428	1.0
129	1.1	229	0.3	329	1.0	429	1.0
130	1.1	230	0.3	330	1.0	430	1.0
131	1.1	231	0.3	331	1.0	431	1.0
132	1.1	232	0.3	332	1.0	432	1.0
133	1.1	233	0.3	333	1.0	433	1.0
134	1.1	234	0.3	334	1.0	434	1.0
135	1.1	235	0.3	335	1.0	435	1.0
136	1.1	236	0.3	336	1.0	436	1.0
137	1.1	237	0.3	337	1.0	437	1.0
138	1.1	238	0.3	338	1.0	438	1.0
139	1.1	239	0.3	339	1.0	439	1.0
140	1.1	240	0.3	340	1.0	440	1.0

Table IX

## TAPE CONTACT DISTANCES (mm) FOR TAPE No. 8

No.	DISTANCE	No.	DISTANCE	No.	DISTANCE	No.	DISTANCE
301	1.0	315	5.3	328	31.5	341	1.3
302	6.9	316	1.6	329	3.1	342	6.4
303	4.7	317	11.7	330	5.1	343	7.9
304	26.5	318	2.6	331	1.0	344	4.7
305	2.1	319	5.0	332	15.1	345	2.7
306	2.0	320	1.1	333	.8	346	2.0
307	1.0	321	11.9	334	3.1	347	27.8
308	2.4	322	.7	335	1.5	348	6.2
309	15.3	323	15.6	336	3.0	349	5.0
310	1.2	324	7.5	337	2.5	350	8.2
311	2.4	325	1.6	338	3.9	351	3.7
312	1.7	326	1.5	339	2.6	352	2.7
313	5.0	327	6.7	340	6.5	353	1.5
314	4.0						



TABLE 13

TABLE CONTACT DISTANCES (mm) FROM EARLY NO. 2

EARLY NO. 2	CONTACT DISTANCE (mm)	EARLY NO. 2	CONTACT DISTANCE (mm)	EARLY NO. 2	CONTACT DISTANCE (mm)	EARLY NO. 2	CONTACT DISTANCE (mm)
201	1.0	217	2.3	233	1.2	249	1.3
202	0.2	218	1.6	234	1.1	250	0.4
203	4.1	219	11.1	235	0.1	251	1.0
204	0.2	220	0.0	236	1.0	252	0.1
205	5.1	221	2.4	237	1.2	253	0.1
206	0.0	222	1.1	238	1.1	254	0.0
207	1.0	223	11.2	239	1.2	255	0.1
208	0.4	224	1.1	240	1.2	256	0.2
209	12.3	225	12.6	241	1.2	257	0.0
210	1.5	226	1.2	242	1.2	258	0.5
211	5.4	227	1.6	243	1.2	259	1.1
212	1.3	228	1.2	244	0.6	260	0.1
213	0.0	229	0.3	245	0.3	261	1.2
214	4.0	230	0.1	246	0.1	262	0.1
215	0.1	231	0.1	247	0.1	263	0.1
216	0.1	232	0.1	248	0.1	264	0.1
217	12.1	233	0.1	249	0.1	265	0.1
218	0.1	234	0.1	250	0.1	266	0.1
219	0.1	235	0.1	251	0.1	267	0.1
220	0.1	236	0.1	252	0.1	268	0.1
221	0.1	237	0.1	253	0.1	269	0.1
222	0.1	238	0.1	254	0.1	270	0.1
223	0.1	239	0.1	255	0.1	271	0.1
224	0.1	240	0.1	256	0.1	272	0.1
225	0.1	241	0.1	257	0.1	273	0.1
226	0.1	242	0.1	258	0.1	274	0.1
227	0.1	243	0.1	259	0.1	275	0.1
228	0.1	244	0.1	260	0.1	276	0.1
229	0.1	245	0.1	261	0.1	277	0.1
230	0.1	246	0.1	262	0.1	278	0.1
231	0.1	247	0.1	263	0.1	279	0.1
232	0.1	248	0.1	264	0.1	280	0.1
233	0.1	249	0.1	265	0.1	281	0.1
234	0.1	250	0.1	266	0.1	282	0.1
235	0.1	251	0.1	267	0.1	283	0.1
236	0.1	252	0.1	268	0.1	284	0.1
237	0.1	253	0.1	269	0.1	285	0.1
238	0.1	254	0.1	270	0.1	286	0.1
239	0.1	255	0.1	271	0.1	287	0.1
240	0.1	256	0.1	272	0.1	288	0.1
241	0.1	257	0.1	273	0.1	289	0.1
242	0.1	258	0.1	274	0.1	290	0.1
243	0.1	259	0.1	275	0.1	291	0.1
244	0.1	260	0.1	276	0.1	292	0.1
245	0.1	261	0.1	277	0.1	293	0.1
246	0.1	262	0.1	278	0.1	294	0.1
247	0.1	263	0.1	279	0.1	295	0.1
248	0.1	264	0.1	280	0.1	296	0.1
249	0.1	265	0.1	281	0.1	297	0.1
250	0.1	266	0.1	282	0.1	298	0.1
251	0.1	267	0.1	283	0.1	299	0.1
252	0.1	268	0.1	284	0.1	300	0.1
253	0.1	269	0.1	285	0.1	301	0.1
254	0.1	270	0.1	286	0.1	302	0.1
255	0.1	271	0.1	287	0.1	303	0.1
256	0.1	272	0.1	288	0.1	304	0.1
257	0.1	273	0.1	289	0.1	305	0.1
258	0.1	274	0.1	290	0.1	306	0.1
259	0.1	275	0.1	291	0.1	307	0.1
260	0.1	276	0.1	292	0.1	308	0.1
261	0.1	277	0.1	293	0.1	309	0.1
262	0.1	278	0.1	294	0.1	310	0.1
263	0.1	279	0.1	295	0.1	311	0.1
264	0.1	280	0.1	296	0.1	312	0.1
265	0.1	281	0.1	297	0.1	313	0.1
266	0.1	282	0.1	298	0.1	314	0.1
267	0.1	283	0.1	299	0.1	315	0.1
268	0.1	284	0.1	300	0.1	316	0.1
269	0.1	285	0.1	301	0.1	317	0.1
270	0.1	286	0.1	302	0.1	318	0.1
271	0.1	287	0.1	303	0.1	319	0.1
272	0.1	288	0.1	304	0.1	320	0.1
273	0.1	289	0.1	305	0.1	321	0.1
274	0.1	290	0.1	306	0.1	322	0.1
275	0.1	291	0.1	307	0.1	323	0.1
276	0.1	292	0.1	308	0.1	324	0.1
277	0.1	293	0.1	309	0.1	325	0.1
278	0.1	294	0.1	310	0.1	326	0.1
279	0.1	295	0.1	311	0.1	327	0.1
280	0.1	296	0.1	312	0.1	328	0.1
281	0.1	297	0.1	313	0.1	329	0.1
282	0.1	298	0.1	314	0.1	330	0.1
283	0.1	299	0.1	315	0.1	331	0.1
284	0.1	300	0.1	316	0.1	332	0.1
285	0.1	301	0.1	317	0.1	333	0.1
286	0.1	302	0.1	318	0.1	334	0.1
287	0.1	303	0.1	319	0.1	335	0.1
288	0.1	304	0.1	320	0.1	336	0.1
289	0.1	305	0.1	321	0.1	337	0.1
290	0.1	306	0.1	322	0.1	338	0.1
291	0.1	307	0.1	323	0.1	339	0.1
292	0.1	308	0.1	324	0.1	340	0.1
293	0.1	309	0.1	325	0.1	341	0.1
294	0.1	310	0.1	326	0.1	342	0.1
295	0.1	311	0.1	327	0.1	343	0.1
296	0.1	312	0.1	328	0.1	344	0.1
297	0.1	313	0.1	329	0.1	345	0.1
298	0.1	314	0.1	330	0.1	346	0.1
299	0.1	315	0.1	331	0.1	347	0.1
300	0.1	316	0.1	332	0.1	348	0.1
301	0.1	317	0.1	333	0.1	349	0.1
302	0.1	318	0.1	334	0.1	350	0.1
303	0.1	319	0.1	335	0.1	351	0.1
304	0.1	320	0.1	336	0.1	352	0.1
305	0.1	321	0.1	337	0.1	353	0.1
306	0.1	322	0.1	338	0.1	354	0.1
307	0.1	323	0.1	339	0.1	355	0.1
308	0.1	324	0.1	340	0.1	356	0.1
309	0.1	325	0.1	341	0.1	357	0.1
310	0.1	326	0.1	342	0.1	358	0.1
311	0.1	327	0.1	343	0.1	359	0.1
312	0.1	328	0.1	344	0.1	360	0.1
313	0.1	329	0.1	345	0.1	361	0.1
314	0.1	330	0.1	346	0.1	362	0.1
315	0.1	331	0.1	347	0.1	363	0.1
316	0.1	332	0.1	348	0.1	364	0.1
317	0.1	333	0.1	349	0.1	365	0.1
318	0.1	334	0.1	350	0.1	366	0.1
319	0.1	335	0.1	351	0.1	367	0.1
320	0.1	336	0.1	352	0.1	368	0.1
321	0.1	337	0.1	353	0.1	369	0.1
322	0.1	338	0.1	354	0.1	370	0.1
323	0.1	339	0.1	355	0.1	371	0.1
324	0.1	340	0.1	356	0.1	372	0.1
325	0.1	341	0.1	357	0.1	373	0.1
326	0.1	342	0.1	358	0.1	374	0.1
327	0.1	343	0.1	359	0.1	375	0.1
328	0.1	344	0.1	360	0.1	376	0.1
329	0.1	345	0.1	361	0.1	377	0.1
330	0.1	346	0.1	362	0.1	378	0.1
331	0.1	347	0.1	363	0.1	379	0.1
332	0.1	348	0.1	364	0.1	380	0.1
333	0.1	349	0.1	365	0.1	381	0.1
334	0.1	350	0.1	366	0.1	382	0.1
335	0.1	351	0.1	367	0.1	383	0.1
336	0.1	352	0.1	368	0.1	384	0.1
337	0.1	353	0.1	369	0.1	385	0.1
338	0.1	354	0.1	370	0.1	386	0.1
339	0.1	355	0.1	371	0.1	387	0.1
340	0.1	356	0.1	372	0.1	388	0.1
341	0.1	357	0.1	373	0.1	389	0.1
342	0.1	358	0.1	374	0.1	390	0.1
343	0.1	359	0.1	375	0.1	391	0.1
344	0.1	360	0.1	376	0.1	392	0.1
345	0.1	361	0.1	377	0.1	393	0.1
346	0.1	362	0.1	378	0.1	394	0.1
347	0.1	363	0.1	379	0.1	395	0.1
348	0.1	364	0.1	380	0.1	396	0.1
349	0.1	365	0.1	381	0.1	397	0.1
350	0.1	366	0.1	382	0.1	398	0.1
351	0.1	367	0.1	383	0.1	399	0.1
352	0.1	368	0.1	384	0.1	400	0.1
353	0.1	369	0.1	385	0.1	401	0.1
354	0.1	370	0.1	386	0.1	402	0.1
355	0.1	371	0.1	387	0.1	403	0.1
356	0.1	372	0.1	388	0.1	404	0.1
357	0.1	373	0.1	389	0.1	405	0.1
358	0.1	374	0.1	390	0.1	406	0.1
359	0.1	375	0.1	391	0.1	407	0.1
360	0.1	376	0.1	392	0.1	408	0.1
361	0.1	377	0.1	393	0.1	409	0.1
362	0.1	378	0.1	394	0.1	410	0.1
363	0.1	379	0.1	395	0.1	411	0.1
364	0.1	380	0.1	396	0.1	412	0.1
365	0.1	381	0.1	397	0.1	413	0.1
366	0.1	382	0.1	398	0.1	414	0.1
367	0.1	383	0.1	399	0.1	415	0.1
368	0.1	384	0.1	400	0.1	416	0.1
369	0.1	385	0.1	401	0.1	417	0.1
370	0.1	386	0.1	402	0.1	418	0.1
371	0.1	387	0.1	403	0.1	419	0.1
372	0.1	388	0.1	404	0.1	420	0.1
373	0.1	389	0.1	405	0.1	421	0.1
374	0.1	390	0.1	406	0.1	422	0.1
375	0.1	391	0.1	407	0.1	423	0.1
376	0.1	392	0.1	408	0.1		

Table X

## TAPE CONTACT DISTANCES (mm) FOR TAPE No. 9

No.	DISTANCE	No.	DISTANCE	No.	DISTANCE	No.	DISTANCE
1	12.4	26	2.5	51	1.1	76	7.1
2	4.0	27	4.6	52	14.0	77	6.8
3	6.9	28	2.3	53	14.9	78	11.2
4	1.2	29	1.9	54	1.0	79	3.1
5	2.5	30	22.9	55	3.9	80	2.1
6	5.5	31	7.4	56	1.1	81	7.3
7	7.3	32	3.5	57	1.2	82	4.2
8	2.3	33	2.4	58	4.0	83	1.4
9	1.2	34	11.6	59	9.4	84	3.9
10	.7	35	5.0	60	1.1	85	.5
11	4.5	36	1.9	61	2.8	86	24.5
12	10.8	37	5.6	62	4.0	87	2.9
13	3.2	38	9.7	63	3.2	88	28.0
14	2.3	39	20.0	64	7.4	89	1.6
15	6.2	40	2.7	65	2.0	90	3.1
16	10.0	41	1.5	66	6.5	91	2.7
17	4.9	42	1.7	67	3.7	92	3.1
18	3.1	43	1.8	68	1.7	93	9.0
19	3.3	44	1.0	69	.5	94	2.0
20	5.6	45	.9	70	1.9	95	3.1
21	3.9	46	9.9	71	9.4	96	18.2
22	3.8	47	10.2	72	4.8	97	2.1
23	4.0	48	6.7	73	4.1	98	1.6
24	1.2	49	14.0	74	14.7	99	1.2
25	4.0	50	37.8	75	2.8	100	2.1

# TABLE 1

WATER TEMPERATURES (°F) FOR YEAR 1961

STATION	NO.	TEMP.	STATION	NO.	TEMP.	STATION	NO.	TEMP.
1	10	55.0	11	20	55.0	21	30	55.0
2	11	55.0	12	21	55.0	22	31	55.0
3	12	55.0	13	22	55.0	23	32	55.0
4	13	55.0	14	23	55.0	24	33	55.0
5	14	55.0	15	24	55.0	25	34	55.0
6	15	55.0	16	25	55.0	26	35	55.0
7	16	55.0	17	26	55.0	27	36	55.0
8	17	55.0	18	27	55.0	28	37	55.0
9	18	55.0	19	28	55.0	29	38	55.0
10	19	55.0	20	29	55.0	30	39	55.0
11	20	55.0	21	30	55.0	31	40	55.0
12	21	55.0	22	31	55.0	32	41	55.0
13	22	55.0	23	32	55.0	33	42	55.0
14	23	55.0	24	33	55.0	34	43	55.0
15	24	55.0	25	34	55.0	35	44	55.0
16	25	55.0	26	35	55.0	36	45	55.0
17	26	55.0	27	36	55.0	37	46	55.0
18	27	55.0	28	37	55.0	38	47	55.0
19	28	55.0	29	38	55.0	39	48	55.0
20	29	55.0	30	39	55.0	40	49	55.0
21	30	55.0	31	40	55.0	41	50	55.0
22	31	55.0	32	41	55.0	42	51	55.0
23	32	55.0	33	42	55.0	43	52	55.0
24	33	55.0	34	43	55.0	44	53	55.0
25	34	55.0	35	44	55.0	45	54	55.0
26	35	55.0	36	45	55.0	46	55	55.0
27	36	55.0	37	46	55.0	47	56	55.0
28	37	55.0	38	47	55.0	48	57	55.0
29	38	55.0	39	48	55.0	49	58	55.0
30	39	55.0	40	49	55.0	50	59	55.0
31	40	55.0	41	50	55.0	51	60	55.0
32	41	55.0	42	51	55.0	52	61	55.0
33	42	55.0	43	52	55.0	53	62	55.0
34	43	55.0	44	53	55.0	54	63	55.0
35	44	55.0	45	54	55.0	55	64	55.0
36	45	55.0	46	55	55.0	56	65	55.0
37	46	55.0	47	56	55.0	57	66	55.0
38	47	55.0	48	57	55.0	58	67	55.0
39	48	55.0	49	58	55.0	59	68	55.0
40	49	55.0	50	59	55.0	60	69	55.0
41	50	55.0	51	60	55.0	61	70	55.0
42	51	55.0	52	61	55.0	62	71	55.0
43	52	55.0	53	62	55.0	63	72	55.0
44	53	55.0	54	63	55.0	64	73	55.0
45	54	55.0	55	64	55.0	65	74	55.0
46	55	55.0	56	65	55.0	66	75	55.0
47	56	55.0	57	66	55.0	67	76	55.0
48	57	55.0	58	67	55.0	68	77	55.0
49	58	55.0	59	68	55.0	69	78	55.0
50	59	55.0	60	69	55.0	70	79	55.0
51	60	55.0	61	70	55.0	71	80	55.0
52	61	55.0	62	71	55.0	72	81	55.0
53	62	55.0	63	72	55.0	73	82	55.0
54	63	55.0	64	73	55.0	74	83	55.0
55	64	55.0	65	74	55.0	75	84	55.0
56	65	55.0	66	75	55.0	76	85	55.0
57	66	55.0	67	76	55.0	77	86	55.0
58	67	55.0	68	77	55.0	78	87	55.0
59	68	55.0	69	78	55.0	79	88	55.0
60	69	55.0	70	79	55.0	80	89	55.0
61	70	55.0	71	80	55.0	81	90	55.0
62	71	55.0	72	81	55.0	82	91	55.0
63	72	55.0	73	82	55.0	83	92	55.0
64	73	55.0	74	83	55.0	84	93	55.0
65	74	55.0	75	84	55.0	85	94	55.0
66	75	55.0	76	85	55.0	86	95	55.0
67	76	55.0	77	86	55.0	87	96	55.0
68	77	55.0	78	87	55.0	88	97	55.0
69	78	55.0	79	88	55.0	89	98	55.0
70	79	55.0	80	89	55.0	90	99	55.0
71	80	55.0	81	90	55.0	91	100	55.0
72	81	55.0	82	91	55.0	92	101	55.0
73	82	55.0	83	92	55.0	93	102	55.0
74	83	55.0	84	93	55.0	94	103	55.0
75	84	55.0	85	94	55.0	95	104	55.0
76	85	55.0	86	95	55.0	96	105	55.0
77	86	55.0	87	96	55.0	97	106	55.0
78	87	55.0	88	97	55.0	98	107	55.0
79	88	55.0	89	98	55.0	99	108	55.0
80	89	55.0	90	99	55.0	100	109	55.0
81	90	55.0	91	100	55.0	101	110	55.0
82	91	55.0	92	101	55.0	102	111	55.0
83	92	55.0	93	102	55.0	103	112	55.0
84	93	55.0	94	103	55.0	104	113	55.0
85	94	55.0	95	104	55.0	105	114	55.0
86	95	55.0	96	105	55.0	106	115	55.0
87	96	55.0	97	106	55.0	107	116	55.0
88	97	55.0	98	107	55.0	108	117	55.0
89	98	55.0	99	108	55.0	109	118	55.0
90	99	55.0	100	109	55.0	110	119	55.0
91	100	55.0	101	110	55.0	111	120	55.0
92	101	55.0	102	111	55.0	112	121	55.0
93	102	55.0	103	112	55.0	113	122	55.0
94	103	55.0	104	113	55.0	114	123	55.0
95	104	55.0	105	114	55.0	115	124	55.0
96	105	55.0	106	115	55.0	116	125	55.0
97	106	55.0	107	116	55.0	117	126	55.0
98	107	55.0	108	117	55.0	118	127	55.0
99	108	55.0	109	118	55.0	119	128	55.0
100	109	55.0	110	119	55.0	120	129	55.0
101	110	55.0	111	120	55.0	121	130	55.0
102	111	55.0	112	121	55.0	122	131	55.0
103	112	55.0	113	122	55.0	123	132	55.0
104	113	55.0	114	123	55.0	124	133	55.0
105	114	55.0	115	124	55.0	125	134	55.0
106	115	55.0	116	125	55.0	126	135	55.0
107	116	55.0	117	126	55.0	127	136	55.0
108	117	55.0	118	127	55.0	128	137	55.0
109	118	55.0	119	128	55.0	129	138	55.0
110	119	55.0	120	129	55.0	130	139	55.0
111	120	55.0	121	130	55.0	131	140	55.0
112	121	55.0	122	131	55.0	132	141	55.0
113	122	55.0	123	132	55.0	133	142	55.0
114	123	55.0	124	133	55.0	134	143	55.0
115	124	55.0	125	134	55.0	135	144	55.0
116	125	55.0	126	135	55.0	136	145	55.0
117	126	55.0	127	136	55.0	137	146	55.0
118	127	55.0	128	137	55.0	138	147	55.0
119	128	55.0	129	138	55.0	139	148	55.0
120	129	55.0	130	139	55.0	140	149	55.0
121	130	55.0	131	140	55.0	141	150	55.0
122	131	55.0	132	141	55.0	142	151	55.0
123	132	55.0	133	142	55.0	143	152	55.0
124	133	55.0	134	143	55.0	144	153	55.0
125	134	55.0	135	144	55.0	145	154	55.0
126	135	55.0	136	145	55.0	146	155	55.0
127	136	55.0	137	146	55.0	147	156	55.0
128	137	55.0	138	147	55.0	148	157	55.0
129	138	55.0	139	148	55.0	149	158	55.0
130	139	55.0	140	149	55.0	150	159	55.0
131	140	55.0	141	150	55.0	151	160	55.0
132	141	55.0	142	151	55.0	152	161	55.0
133	142	55.0	143	152	55.0	153	162	55.0
134	143	55.0	144	153	55.0	154	163	55.0
135	144	55.0	145	154	55.0	155	164	55.0
136	145	55.0	146	155	55.0	156	165	55.0
137	146	55.0	147	156	55.0	157	166	55.0
138	147	55.0	148	157	55.0	158	167	55.0
139	148	55.0	149	158	55.0	159	168	55.0
140	149	55.0	150	159	55.0	160	169	55.0
141	150	55.0	151	160	55.0	161	170	55.0
142	151	55.0	152	161	55.0	162	171	55.0
143	152	55.0	153	162	55.0	163	172	55.0
144	153	55.0	154	163	55.0	164	173	55.0
145	154	55.0	155	164	55.0	165	174	55.0
146	155	55.0	156	165	55.0	166	175	55.0
147	156	55.0	157	166	55.0	167	176	55.0
148	157	55.0	158	167	55.0	168	177	55.0
149	158	55.0	159	168	55.0	169	178	55.0
150	159	55.0	160	169	55.0	170	179	55.0
151	160	55.0	161	170	55.0	171	180	55.0
152	161	55.0	162	171	55.0	172	181	55.0
153	162	55.0	163	172	55.0	173	182	55.0
154	163	55.0	164	173	55.0	174	183	55.0
155	164	55.0	165	174	55.0	175	184	55.0
156	165	55.0	166	175	55.0	176	185	55.0
157	166	55.0	167	176	55.0	177	186	55.0
158	167	55.0	168	177	55.0	178	187	55.0
159	168	55.0	169	178	55.0	179	188	55.

Table X

## TAPE CONTACT DISTANCES (mm) FOR TAPE No. 9

No.	DISTANCE	No.	DISTANCE	No.	DISTANCE	No.	DISTANCE
101	3.4	126	10.8	151	4.9	175	1.0
102	2.5	127	6.3	152	2.8	176	6.2
103	11.6	128	1.4	153	3.4	177	2.5
104	5.9	129	1.1	154	35.0	178	4.1
105	1.1	130	3.3	155	4.0	179	5.2
106	12.2	131	3.4	156	1.4	180	2.4
107	2.7	132	12.9	157	13.0	181	11.4
108	3.0	133	3.0	158	3.3	182	1.7
109	1.9	134	1.9	159	7.2	183	2.0
110	17.9	135	2.3	160	7.5	184	.5
111	10.9	136	1.8	161	8.0	185	9.1
112	3.1	137	1.5	162	2.3	186	5.1
113	2.2	138	8.8	163	2.2	187	1.3
114	11.7	139	3.0	164	.6	188	1.0
115	8.5	140	1.2	165	2.4	189	.8
116	2.4	141	20.4	166	2.9	190	2.0
117	1.1	142	1.9	167	2.0	191	.5
118	21.7	143	17.7	168	2.3	192	1.1
119	1.4	144	3.6	169	1.3	193	6.9
120	1.3	145	16.9	170	2.0	194	2.5
121	2.2	146	2.6	171	3.8	195	1.2
122	.5	147	2.0	172	7.1	196	7.5
123	3.9	148	1.9	173	2.2	197	1.4
124	1.7	149	1.7	174	1.9	198	2.1
125	.6	150	2.8				



TABLE 1

LIST OF CONTACT DISTANCES (m) FOR EACH NO.

NO.	DISTANCE	NO.	DISTANCE	NO.	DISTANCE	NO.	DISTANCE
101	1.0	151	1.0	201	1.0	251	1.0
102	5.5	152	5.5	202	5.5	252	5.5
103	11.0	153	11.0	203	11.0	253	11.0
104	5.5	154	5.5	204	5.5	254	5.5
105	1.1	155	1.1	205	1.1	255	1.1
106	15.5	156	15.5	206	15.5	256	15.5
107	5.5	157	5.5	207	5.5	257	5.5
108	1.0	158	1.0	208	1.0	258	1.0
109	1.0	159	1.0	209	1.0	259	1.0
110	17.5	160	17.5	210	17.5	260	17.5
111	10.0	161	10.0	211	10.0	261	10.0
112	5.1	162	5.1	212	5.1	262	5.1
113	5.5	163	5.5	213	5.5	263	5.5
114	11.5	164	11.5	214	11.5	264	11.5
115	5.5	165	5.5	215	5.5	265	5.5
116	5.5	166	5.5	216	5.5	266	5.5
117	5.5	167	5.5	217	5.5	267	5.5
118	51.5	168	51.5	218	51.5	268	51.5
119	1.5	169	1.5	219	1.5	269	1.5
120	1.5	170	1.5	220	1.5	270	1.5
121	5.5	171	5.5	221	5.5	271	5.5
122	5.5	172	5.5	222	5.5	272	5.5
123	1.5	173	1.5	223	1.5	273	1.5
124	1.5	174	1.5	224	1.5	274	1.5
125	5.5	175	5.5	225	5.5	275	5.5
126	5.5	176	5.5	226	5.5	276	5.5
127	1.5	177	1.5	227	1.5	277	1.5
128	1.5	178	1.5	228	1.5	278	1.5
129	1.5	179	1.5	229	1.5	279	1.5
130	1.5	180	1.5	230	1.5	280	1.5
131	5.5	181	5.5	231	5.5	281	5.5
132	5.5	182	5.5	232	5.5	282	5.5
133	1.5	183	1.5	233	1.5	283	1.5
134	1.5	184	1.5	234	1.5	284	1.5
135	1.5	185	1.5	235	1.5	285	1.5
136	1.5	186	1.5	236	1.5	286	1.5
137	1.5	187	1.5	237	1.5	287	1.5
138	1.5	188	1.5	238	1.5	288	1.5
139	1.5	189	1.5	239	1.5	289	1.5
140	1.5	190	1.5	240	1.5	290	1.5
141	1.5	191	1.5	241	1.5	291	1.5
142	1.5	192	1.5	242	1.5	292	1.5
143	1.5	193	1.5	243	1.5	293	1.5
144	1.5	194	1.5	244	1.5	294	1.5
145	1.5	195	1.5	245	1.5	295	1.5
146	1.5	196	1.5	246	1.5	296	1.5
147	1.5	197	1.5	247	1.5	297	1.5
148	1.5	198	1.5	248	1.5	298	1.5
149	1.5	199	1.5	249	1.5	299	1.5
150	1.5	200	1.5	250	1.5	300	1.5

Table XI

TAPE CONTACT DISTANCES (mm) FOR TAPE No. 10

No.	DISTANCE	No.	DISTANCE	No.	DISTANCE	No.	DISTANCE
1	18.4	26	2.2	51	6.3	76	31.1
2	5.2	27	1.5	52	4.9	77	4.0
3	15.9	28	5.0	53	4.6	78	1.0
4	19.2	29	11.5	54	3.6	79	8.6
5	21.0	30	2.3	55	.6	80	13.6
6	12.1	31	6.0	56	3.0	81	2.6
7	2.2	32	1.9	57	3.9	82	7.5
8	3.9	33	3.6	58	1.1	83	63.9
9	8.0	34	2.5	59	3.3	84	6.3
10	1.3	35	1.4	60	1.1	85	3.0
11	2.7	36	4.0	61	3.1	86	6.8
12	31.2	37	3.8	62	5.2	87	5.7
13	20.2	38	2.0	63	1.1	88	3.0
14	4.0	39	.7	64	3.2	89	54.5
15	20.3	40	4.8	65	2.3	90	4.5
16	18.5	41	1.9	66	3.4	91	7.7
17	3.2	42	2.9	67	1.9	92	22.2
18	1.0	43	5.3	68	3.4	93	4.5
19	2.4	44	2.2	69	2.7	94	6.3
20	4.6	45	1.1	70	2.6	95	5.2
21	4.1	46	4.4	71	4.9	96	1.6
22	17.7	47	9.9	72	6.3	97	10.0
23	3.9	48	3.3	73	4.3	98	6.2
24	8.2	49	1.1	74	34.6	99	3.0
25	1.7	50	3.5	75	42.6	100	2.1





Table XI

TAPE CONTACT DISTANCES (mm) FOR TAPE No. 10

No.	DISTANCE	No.	DISTANCE	No.	DISTANCE	No.	DISTANCE
101	1.3	126	3.9	151	5.1	176	3.3
102	10.0	127	19.4	152	5.0	177	2.0
103	4.4	128	37.0	153	5.0	178	2.2
104	7.6	129	.5	154	.9	179	2.9
105	3.6	130	3.0	155	2.6	180	2.5
106	11.7	131	6.6	156	2.2	181	2.6
107	15.9	132	1.5	157	3.9	182	2.7
108	2.8	133	3.6	158	9.4	183	2.1
109	6.5	134	7.0	159	1.9	184	2.0
110	.8	135	3.2	160	3.6	185	2.0
111	3.4	136	3.2	161	1.2	186	12.0
112	20.0	137	1.3	162	1.8	187	2.3
113	3.5	138	2.9	163	8.0	188	1.3
114	6.0	139	4.1	164	2.6	189	1.8
115	12.0	140	3.9	165	.8	190	3.8
116	3.6	141	5.3	166	3.8	191	8.8
117	9.9	142	8.0	167	2.0	192	7.6
118	4.4	143	5.8	168	1.7	193	16.4
119	4.3	144	4.5	169	2.2	194	4.4
120	3.8	145	5.3	170	1.7	195	1.5
121	2.9	146	6.8	171	2.3	196	12.6
122	20.0	147	2.0	172	7.0	197	1.5
123	4.0	148	2.5	173	3.4	198	1.6
124	4.1	149	7.3	174	1.3	199	1.2
125	16.5	150	1.7	175	1.6	200	1.2



TABLE II

TABLE OF CONTACT DISTANCES (MILES) FOR THE YEAR 1901

NO.	DISTANCE	NO.	DISTANCE	NO.	DISTANCE	NO.	DISTANCE
101	1.2	151	1.2	201	1.2	251	1.2
102	1.2	152	1.2	202	1.2	252	1.2
103	1.2	153	1.2	203	1.2	253	1.2
104	1.2	154	1.2	204	1.2	254	1.2
105	1.2	155	1.2	205	1.2	255	1.2
106	1.2	156	1.2	206	1.2	256	1.2
107	1.2	157	1.2	207	1.2	257	1.2
108	1.2	158	1.2	208	1.2	258	1.2
109	1.2	159	1.2	209	1.2	259	1.2
110	1.2	160	1.2	210	1.2	260	1.2
111	1.2	161	1.2	211	1.2	261	1.2
112	1.2	162	1.2	212	1.2	262	1.2
113	1.2	163	1.2	213	1.2	263	1.2
114	1.2	164	1.2	214	1.2	264	1.2
115	1.2	165	1.2	215	1.2	265	1.2
116	1.2	166	1.2	216	1.2	266	1.2
117	1.2	167	1.2	217	1.2	267	1.2
118	1.2	168	1.2	218	1.2	268	1.2
119	1.2	169	1.2	219	1.2	269	1.2
120	1.2	170	1.2	220	1.2	270	1.2
121	1.2	171	1.2	221	1.2	271	1.2
122	1.2	172	1.2	222	1.2	272	1.2
123	1.2	173	1.2	223	1.2	273	1.2
124	1.2	174	1.2	224	1.2	274	1.2
125	1.2	175	1.2	225	1.2	275	1.2
126	1.2	176	1.2	226	1.2	276	1.2
127	1.2	177	1.2	227	1.2	277	1.2
128	1.2	178	1.2	228	1.2	278	1.2
129	1.2	179	1.2	229	1.2	279	1.2
130	1.2	180	1.2	230	1.2	280	1.2
131	1.2	181	1.2	231	1.2	281	1.2
132	1.2	182	1.2	232	1.2	282	1.2
133	1.2	183	1.2	233	1.2	283	1.2
134	1.2	184	1.2	234	1.2	284	1.2
135	1.2	185	1.2	235	1.2	285	1.2
136	1.2	186	1.2	236	1.2	286	1.2
137	1.2	187	1.2	237	1.2	287	1.2
138	1.2	188	1.2	238	1.2	288	1.2
139	1.2	189	1.2	239	1.2	289	1.2
140	1.2	190	1.2	240	1.2	290	1.2
141	1.2	191	1.2	241	1.2	291	1.2
142	1.2	192	1.2	242	1.2	292	1.2
143	1.2	193	1.2	243	1.2	293	1.2
144	1.2	194	1.2	244	1.2	294	1.2
145	1.2	195	1.2	245	1.2	295	1.2
146	1.2	196	1.2	246	1.2	296	1.2
147	1.2	197	1.2	247	1.2	297	1.2
148	1.2	198	1.2	248	1.2	298	1.2
149	1.2	199	1.2	249	1.2	299	1.2
150	1.2	200	1.2	250	1.2	300	1.2

Table XI

TAPE CONTACT DISTANCES (mm) FOR TAPE No. 10

No.	DISTANCE	No.	DISTANCE	No.	DISTANCE	No.	DISTANCE
201	1.5	210	1.3	219	1.6	228	3.5
202	2.1	211	2.6	220	3.1	229	6.6
203	1.7	212	1.9	221	4.7	230	3.5
204	2.0	213	1.3	222	2.4	231	2.0
205	5.3	214	1.7	223	3.9	232	11.5
206	12.0	215	2.0	224	.7	233	1.9
207	3.6	216	8.1	225	3.3	234	3.2
208	1.6	217	5.7	226	4.9	235	1.9
209	5.1	218	2.7	227	9.0	236	.7

Table 11

TIME COURSE OF ALUMINUM (mg) FOR EACH NO. 10

NO.	TIME	NO.	TIME	NO.	TIME	NO.	TIME
101	1.0	102	1.0	103	1.0	104	1.0
105	1.0	106	1.0	107	1.0	108	1.0
109	1.0	110	1.0	111	1.0	112	1.0
113	1.0	114	1.0	115	1.0	116	1.0
117	1.0	118	1.0	119	1.0	120	1.0
121	1.0	122	1.0	123	1.0	124	1.0
125	1.0	126	1.0	127	1.0	128	1.0
129	1.0	130	1.0	131	1.0	132	1.0
133	1.0	134	1.0	135	1.0	136	1.0
137	1.0	138	1.0	139	1.0	140	1.0
141	1.0	142	1.0	143	1.0	144	1.0
145	1.0	146	1.0	147	1.0	148	1.0
149	1.0	150	1.0	151	1.0	152	1.0
153	1.0	154	1.0	155	1.0	156	1.0
157	1.0	158	1.0	159	1.0	160	1.0
161	1.0	162	1.0	163	1.0	164	1.0
165	1.0	166	1.0	167	1.0	168	1.0
169	1.0	170	1.0	171	1.0	172	1.0
173	1.0	174	1.0	175	1.0	176	1.0
177	1.0	178	1.0	179	1.0	180	1.0
181	1.0	182	1.0	183	1.0	184	1.0
185	1.0	186	1.0	187	1.0	188	1.0
189	1.0	190	1.0	191	1.0	192	1.0
193	1.0	194	1.0	195	1.0	196	1.0
197	1.0	198	1.0	199	1.0	200	1.0

Table XII

## TAPE CONTACT DISTANCES (mm) FOR TAPE No. 11

No.	DISTANCE	No.	DISTANCE	No.	DISTANCE	No.	DISTANCE
1	1.7	26	1.9	51	11.7	76	4.4
2	1.3	27	2.0	52	2.0	77	2.7
3	5.0	28	1.8	53	7.8	78	4.6
4	1.9	29	2.3	54	2.9	79	1.9
5	6.9	30	1.8	55	50.7	80	2.0
6	2.7	31	2.2	56	1.6	81	6.2
7	3.3	32	1.5	57	1.3	82	6.1
8	1.7	33	3.2	58	2.0	83	1.5
9	4.5	34	3.5	59	7.5	84	3.1
10	6.3	35	1.6	60	1.1	85	5.5
11	1.6	36	1.4	61	14.7	86	1.9
12	2.0	37	17.1	62	3.0	87	.8
13	1.3	38	1.4	63	2.8	88	4.1
14	6.6	39	2.0	64	1.6	89	1.0
15	.7	40	1.5	65	9.3	90	6.3
16	1.3	41	1.5	66	1.9	91	10.6
17	2.3	42	2.0	67	1.6	92	1.5
18	7.1	43	3.3	68	2.9	93	3.8
19	1.0	44	4.3	69	.9	94	3.4
20	3.6	45	2.4	70	10.0	95	1.7
21	10.3	46	6.0	71	2.0	96	1.6
22	3.4	47	3.0	72	1.3	97	1.7
23	2.9	48	2.0	73	1.6	98	7.7
24	1.8	49	9.7	74	1.6	99	7.4
25	2.1	50	2.0	75	16.0	100	1.2



# TABLE 11

TABLE 11. CONTINUED. (See Table 10 for title and description.)

NO.	DISTANCE	NO.	DISTANCE	NO.	DISTANCE	NO.	DISTANCE
1	1.1	20	1.1	39	1.1	58	1.1
2	1.3	21	1.3	40	1.3	59	1.3
3	2.0	22	1.8	41	1.8	60	2.0
4	1.8	23	2.3	42	1.8	61	1.8
5	0.9	24	1.8	43	1.8	62	0.9
6	0.7	25	0.9	44	1.8	63	0.7
7	2.3	26	0.9	45	1.8	64	2.3
8	1.1	27	2.0	46	1.8	65	1.1
9	4.2	28	1.2	47	1.8	66	4.2
10	0.3	29	1.1	48	1.8	67	0.3
11	1.0	30	1.4	49	1.8	68	1.0
12	5.0	31	1.1	50	1.8	69	5.0
13	1.3	32	1.4	51	1.8	70	1.3
14	0.0	33	5.0	52	1.8	71	0.0
15	1.3	34	1.8	53	1.8	72	1.3
16	0.0	35	1.8	54	1.8	73	0.0
17	.5	36	1.8	55	1.8	74	.5
18	1.3	37	1.8	56	1.8	75	1.3
19	1.3	38	1.8	57	1.8	76	1.3
20	1.8	39	1.8	58	1.8	77	1.8
21	1.8	40	1.8	59	1.8	78	1.8
22	1.8	41	1.8	60	1.8	79	1.8
23	1.8	42	1.8	61	1.8	80	1.8
24	1.8	43	1.8	62	1.8	81	1.8
25	1.8	44	1.8	63	1.8	82	1.8
26	1.8	45	1.8	64	1.8	83	1.8
27	1.8	46	1.8	65	1.8	84	1.8
28	1.8	47	1.8	66	1.8	85	1.8
29	1.8	48	1.8	67	1.8	86	1.8
30	1.8	49	1.8	68	1.8	87	1.8
31	1.8	50	1.8	69	1.8	88	1.8
32	1.8	51	1.8	70	1.8	89	1.8
33	1.8	52	1.8	71	1.8	90	1.8
34	1.8	53	1.8	72	1.8	91	1.8
35	1.8	54	1.8	73	1.8	92	1.8
36	1.8	55	1.8	74	1.8	93	1.8
37	1.8	56	1.8	75	1.8	94	1.8
38	1.8	57	1.8	76	1.8	95	1.8
39	1.8	58	1.8	77	1.8	96	1.8
40	1.8	59	1.8	78	1.8	97	1.8
41	1.8	60	1.8	79	1.8	98	1.8
42	1.8	61	1.8	80	1.8	99	1.8
43	1.8	62	1.8	81	1.8	100	1.8

Table XII

TAPE CONTACT DISTANCES (mm) FOR TAPE No. 11

No.	DISTANCE	No.	DISTANCE	No.	DISTANCE	No.	DISTANCE
101	11.0	126	6.0	151	1.5	176	1.5
102	1.7	127	3.0	152	1.0	177	3.2
103	9.8	128	13.0	153	11.5	178	1.8
104	5.2	129	1.5	154	1.2	179	14.9
105	.8	130	1.3	155	6.8	180	1.1
106	2.0	131	1.7	156	27.8	181	4.0
107	3.4	132	4.8	157	1.5	182	6.5
108	2.4	133	1.1	158	46.5	183	1.1
109	3.8	134	5.0	159	1.5	184	5.0
110	1.0	135	2.5	160	4.2	185	7.5
111	2.0	136	5.5	161	5.4	186	3.0
112	2.7	137	2.0	162	3.5	187	1.8
113	2.0	138	14.5	163	20.8	188	46.8
114	16.7	139	15.2	164	4.6	189	1.9
115	5.4	140	1.8	165	5.1	190	2.0
116	37.0	141	1.2	166	1.2	191	1.8
117	2.7	142	7.0	167	1.1	192	8.0
118	1.7	143	3.0	168	1.7	193	7.2
119	10.0	144	1.2	169	1.9	194	1.2
120	7.4	145	30.1	170	8.0	195	2.0
121	33.3	146	2.0	171	1.8	196	1.0
122	45.3	147	50.0	172	5.9	197	1.8
123	8.7	148	2.2	173	7.0	198	3.5
124	1.1	149	1.2	174	1.0	199	1.1
125	3.9	150	2.7	175	2.8	200	1.2

TABLE III

MEAN ANNUAL TEMPERATURE (°C) FOR EACH STATION

STATION	NO.	MEAN	NO.	MEAN	NO.	MEAN	NO.	MEAN
101	11.3	120	0.0	129	1.1	138	1.2	
102	1.1	131	2.0	140	1.1	149	1.1	
103	2.2	132	12.0	151	1.2	160	1.0	
104	2.1	133	1.2	152	1.2	161	1.0	
105	2.0	134	1.2	153	1.2	162	1.0	
106	2.0	135	1.1	154	1.1	163	1.0	
107	2.0	136	1.1	155	1.1	164	1.0	
108	2.0	137	1.1	156	1.1	165	1.0	
109	2.0	138	1.1	157	1.1	166	1.0	
110	2.0	139	1.1	158	1.1	167	1.0	
111	2.0	140	1.1	159	1.1	168	1.0	
112	2.0	141	1.1	160	1.1	169	1.0	
113	2.0	142	1.1	161	1.1	170	1.0	
114	2.0	143	1.1	162	1.1	171	1.0	
115	2.0	144	1.1	163	1.1	172	1.0	
116	2.0	145	1.1	164	1.1	173	1.0	
117	2.0	146	1.1	165	1.1	174	1.0	
118	2.0	147	1.1	166	1.1	175	1.0	
119	2.0	148	1.1	167	1.1	176	1.0	
120	2.0	149	1.1	168	1.1	177	1.0	
121	2.0	150	1.1	169	1.1	178	1.0	
122	2.0	151	1.1	170	1.1	179	1.0	
123	2.0	152	1.1	171	1.1	180	1.0	
124	2.0	153	1.1	172	1.1	181	1.0	
125	2.0	154	1.1	173	1.1	182	1.0	
126	2.0	155	1.1	174	1.1	183	1.0	
127	2.0	156	1.1	175	1.1	184	1.0	
128	2.0	157	1.1	176	1.1	185	1.0	
129	2.0	158	1.1	177	1.1	186	1.0	
130	2.0	159	1.1	178	1.1	187	1.0	
131	2.0	160	1.1	179	1.1	188	1.0	
132	2.0	161	1.1	180	1.1	189	1.0	
133	2.0	162	1.1	181	1.1	190	1.0	
134	2.0	163	1.1	182	1.1	191	1.0	
135	2.0	164	1.1	183	1.1	192	1.0	
136	2.0	165	1.1	184	1.1	193	1.0	
137	2.0	166	1.1	185	1.1	194	1.0	
138	2.0	167	1.1	186	1.1	195	1.0	
139	2.0	168	1.1	187	1.1	196	1.0	
140	2.0	169	1.1	188	1.1	197	1.0	
141	2.0	170	1.1	189	1.1	198	1.0	
142	2.0	171	1.1	190	1.1	199	1.0	
143	2.0	172	1.1	191	1.1	200	1.0	
144	2.0	173	1.1	192	1.1			
145	2.0	174	1.1	193	1.1			
146	2.0	175	1.1	194	1.1			
147	2.0	176	1.1	195	1.1			
148	2.0	177	1.1	196	1.1			
149	2.0	178	1.1	197	1.1			
150	2.0	179	1.1	198	1.1			
151	2.0	180	1.1	199	1.1			
152	2.0	181	1.1	200	1.1			



Table XIII

TAPE CONTACT DISTANCES (mm) FOR TAPE No. 12

No.	DISTANCE	No.	DISTANCE	No.	DISTANCE	No.	DISTANCE
1	2.3	26	19.0	51	6.7	76	2.8
2	2.6	27	8.2	52	1.1	77	3.7
3	1.5	28	5.6	53	1.8	78	.8
4	1.5	29	10.0	54	2.0	79	15.0
5	2.0	30	5.0	55	2.7	80	7.3
6	1.8	31	1.8	56	4.1	81	2.8
7	1.1	32	1.0	57	3.0	82	2.3
8	3.7	33	2.0	58	5.0	83	3.4
9	6.0	34	6.7	59	1.8	84	2.4
10	5.0	35	1.8	60	8.6	85	14.0
11	7.9	36	5.1	61	2.0	86	6.3
12	1.0	37	2.4	62	5.0	87	2.7
13	6.4	38	3.0	63	2.5	88	5.2
14	1.0	39	1.4	64	4.2	89	3.5
15	2.7	40	1.4	65	6.4	90	2.8
16	4.0	41	2.5	66	2.2	91	7.0
17	2.3	42	2.0	67	4.9	92	8.6
18	4.9	43	1.0	68	3.6	93	1.5
19	4.0	44	5.0	69	4.1	94	2.6
20	2.5	45	1.4	70	4.0	95	2.2
21	.5	46	2.3	71	10.1	96	2.1
22	1.2	47	1.4	72	4.0	97	2.2
23	8.2	48	2.0	73	6.2	98	5.1
24	5.1	49	4.7	74	2.9	99	2.0
25	3.1	50	4.4	75	5.3	100	2.4



## TABLE III

TANK CONTACT MEASUREMENTS (mm) FOR TANK NO. 12

NO.	DISTANCE	NO.	DISTANCE	NO.	DISTANCE	NO.	DISTANCE
1	5.2	21	6.1	41	11.0	61	5.8
2	5.8	22	1.1	42	8.5	62	2.1
3	1.2	23	1.8	43	2.6	63	8
4	1.2	24	2.0	44	10.0	64	12.0
5	2.0	25	5.1	45	2.0	65	1.3
6	1.2	26	4.1	46	1.5	66	5.8
7	1.1	27	2.0	47	1.0	67	2.3
8	2.1	28	2.4	48	2.0	68	4.4
9	2.0	29	1.0	49	0.1	69	2.4
10	2.0	30	0.0	50	1.8	70	14.0
11	1.2	31	2.0	51	0.1	71	0.2
12	1.0	32	0.0	52	2.4	72	5.1
13	0.4	33	2.2	53	2.0	73	2.5
14	1.0	34	4.5	54	1.4	74	2.2
15	2.1	35	2.4	55	1.2	75	5.8
16	4.0	36	2.5	56	2.2	76	1.0
17	1.2	37	0.2	57	2.0	77	0.0
18	0.2	38	1.0	58	1.0	78	1.0
19	4.0	39	4.1	59	2.0	79	5.0
20	2.2	40	1.0	60	1.0	80	5.2
21	1.2	41	10.1	61	2.2	81	5.1
22	1.0	42	4.0	62	1.0	82	5.5
23	0.2	43	2.2	63	0.0	83	2.1
24	2.0	44	2.2	64	4.1	84	2.0

Table XIII

## TAPE CONTACT DISTANCES (mm) FOR TAPE No. 12

No.	DISTANCE	No.	DISTANCE	No.	DISTANCE	No.	DISTANCE
101	21.0	110	1.6	119	13.6	128	3.6
102	2.1	111	3.0	120	1.4	129	1.5
103	4.0	112	4.7	121	2.1	130	3.2
104	1.3	113	5.1	122	2.8	131	2.4
105	2.0	114	3.2	123	3.2	132	21.4
106	8.5	115	2.7	124	1.7	133	5.8
107	18.8	116	1.7	125	18.6	134	3.3
108	4.9	117	2.8	126	17.0	135	2.1
109	1.6	118	8.2	127	1.8		

# TABLE 1

TABLE 1. (continued) Data for the 1960-1961 season.

STATION NO.	DATE	TIME	WIND DIRECTION	WIND SPEED (MPH)	WAVE HEIGHT (FT)	SEA STATE	WAVE PERIOD (SEC)	WAVE LENGTH (FT)	WAVE ENERGY (KCAL/M <sup>2</sup> )
101	10/1	11:00	110	1.0	1.0	1	1.0	1.0	1.0
102	10/2	11:10	110	2.0	1.0	1	2.0	1.0	1.0
103	10/3	11:15	110	4.0	1.0	1	4.0	1.0	1.0
104	10/4	11:20	110	2.1	1.0	1	2.1	1.0	1.0
105	10/5	11:30	110	2.5	1.0	1	2.5	1.0	1.0
106	10/6	11:35	110	4.0	1.0	1	4.0	1.0	1.0
107	10/7	11:40	110	1.0	1.0	1	1.0	1.0	1.0
108	10/8	11:45	110	2.0	1.0	1	2.0	1.0	1.0
109	10/9	11:50	110	4.0	1.0	1	4.0	1.0	1.0
110	10/10	11:55	110	4.0	1.0	1	4.0	1.0	1.0
111	10/11	12:00	110	1.0	1.0	1	1.0	1.0	1.0
112	10/12	12:05	110	1.0	1.0	1	1.0	1.0	1.0
113	10/13	12:10	110	1.0	1.0	1	1.0	1.0	1.0
114	10/14	12:15	110	1.0	1.0	1	1.0	1.0	1.0
115	10/15	12:20	110	1.0	1.0	1	1.0	1.0	1.0
116	10/16	12:25	110	1.0	1.0	1	1.0	1.0	1.0
117	10/17	12:30	110	1.0	1.0	1	1.0	1.0	1.0
118	10/18	12:35	110	1.0	1.0	1	1.0	1.0	1.0
119	10/19	12:40	110	1.0	1.0	1	1.0	1.0	1.0
120	10/20	12:45	110	1.0	1.0	1	1.0	1.0	1.0
121	10/21	12:50	110	1.0	1.0	1	1.0	1.0	1.0
122	10/22	12:55	110	1.0	1.0	1	1.0	1.0	1.0
123	10/23	13:00	110	1.0	1.0	1	1.0	1.0	1.0
124	10/24	13:05	110	1.0	1.0	1	1.0	1.0	1.0
125	10/25	13:10	110	1.0	1.0	1	1.0	1.0	1.0
126	10/26	13:15	110	1.0	1.0	1	1.0	1.0	1.0
127	10/27	13:20	110	1.0	1.0	1	1.0	1.0	1.0
128	10/28	13:25	110	1.0	1.0	1	1.0	1.0	1.0
129	10/29	13:30	110	1.0	1.0	1	1.0	1.0	1.0
130	10/30	13:35	110	1.0	1.0	1	1.0	1.0	1.0
131	10/31	13:40	110	1.0	1.0	1	1.0	1.0	1.0
132	10/32	13:45	110	1.0	1.0	1	1.0	1.0	1.0
133	10/33	13:50	110	1.0	1.0	1	1.0	1.0	1.0
134	10/34	13:55	110	1.0	1.0	1	1.0	1.0	1.0
135	10/35	14:00	110	1.0	1.0	1	1.0	1.0	1.0
136	10/36	14:05	110	1.0	1.0	1	1.0	1.0	1.0
137	10/37	14:10	110	1.0	1.0	1	1.0	1.0	1.0
138	10/38	14:15	110	1.0	1.0	1	1.0	1.0	1.0
139	10/39	14:20	110	1.0	1.0	1	1.0	1.0	1.0
140	10/40	14:25	110	1.0	1.0	1	1.0	1.0	1.0
141	10/41	14:30	110	1.0	1.0	1	1.0	1.0	1.0
142	10/42	14:35	110	1.0	1.0	1	1.0	1.0	1.0
143	10/43	14:40	110	1.0	1.0	1	1.0	1.0	1.0
144	10/44	14:45	110	1.0	1.0	1	1.0	1.0	1.0
145	10/45	14:50	110	1.0	1.0	1	1.0	1.0	1.0
146	10/46	14:55	110	1.0	1.0	1	1.0	1.0	1.0
147	10/47	15:00	110	1.0	1.0	1	1.0	1.0	1.0
148	10/48	15:05	110	1.0	1.0	1	1.0	1.0	1.0
149	10/49	15:10	110	1.0	1.0	1	1.0	1.0	1.0
150	10/50	15:15	110	1.0	1.0	1	1.0	1.0	1.0

Table XIV

TAPE CONTACT DISTANCES (mm) FOR TAPE NO. 13

No.	DISTANCE	No.	DISTANCE	No.	DISTANCE	No.	DISTANCE
1	26.7	26	13.2	51	1.3	76	7.1
2	34.6	27	9.7	52	4.2	77	4.4
3	10.5	28	4.9	53	2.5	78	1.9
4	4.9	29	2.7	54	1.5	79	2.1
5	1.5	30	3.6	55	1.4	80	5.0
6	5.8	31	3.9	56	5.7	81	2.5
7	5.8	32	6.8	57	5.1	82	3.8
8	5.0	33	25.6	58	11.8	83	11.7
9	2.1	34	.9	59	2.7	84	1.7
10	2.1	35	6.1	60	5.1	85	2.1
11	8.2	36	2.4	61	3.6	86	10.5
12	3.9	37	8.5	62	2.2	87	1.2
13	2.2	38	1.5	63	3.0	88	1.9
14	5.5	39	4.3	64	1.1	89	5.0
15	1.6	40	2.1	65	4.0	90	2.8
16	2.0	41	7.3	66	2.4	91	3.0
17	18.3	42	4.2	67	14.0	92	2.4
18	4.5	43	6.3	68	3.4	93	1.7
19	32.6	44	17.2	69	4.4	94	5.5
20	3.8	45	3.4	70	8.0	95	3.1
21	12.1	46	10.4	71	2.1	96	3.0
22	3.0	47	3.8	72	3.7	97	.8
23	3.2	48	3.2	73	2.4	98	4.0
24	2.0	49	2.0	74	2.0	99	1.7
25	2.0	50	2.2	75	17.0	100	1.7



# Table XIV

TABLE OF CONSTANT DISTANCES (mm) FOR LENS NO. 12

NO.	DISTANCE	NO.	DISTANCE	NO.	DISTANCE	NO.	DISTANCE
1	50.1	50	11.5	1	1.2	10	1.1
2	10.2	51	11.6	2	1.3	11	1.2
3	10.3	52	11.7	3	1.4	12	1.3
4	10.4	53	11.8	4	1.5	13	1.4
5	10.5	54	11.9	5	1.6	14	1.5
6	10.6	55	12.0	6	1.7	15	1.6
7	10.7	56	12.1	7	1.8	16	1.7
8	10.8	57	12.2	8	1.9	17	1.8
9	10.9	58	12.3	9	2.0	18	1.9
10	11.0	59	12.4	10	2.1	19	2.0
11	11.1	60	12.5	11	2.2	20	2.1
12	11.2	61	12.6	12	2.3	21	2.2
13	11.3	62	12.7	13	2.4	22	2.3
14	11.4	63	12.8	14	2.5	23	2.4
15	11.5	64	12.9	15	2.6	24	2.5
16	11.6	65	13.0	16	2.7	25	2.6
17	11.7	66	13.1	17	2.8	26	2.7
18	11.8	67	13.2	18	2.9	27	2.8
19	11.9	68	13.3	19	3.0	28	2.9
20	12.0	69	13.4	20	3.1	29	3.0
21	12.1	70	13.5	21	3.2	30	3.1
22	12.2	71	13.6	22	3.3	31	3.2
23	12.3	72	13.7	23	3.4	32	3.3
24	12.4	73	13.8	24	3.5	33	3.4
25	12.5	74	13.9	25	3.6	34	3.5
26	12.6	75	14.0	26	3.7	35	3.6
27	12.7	76	14.1	27	3.8	36	3.7
28	12.8	77	14.2	28	3.9	37	3.8
29	12.9	78	14.3	29	4.0	38	3.9
30	13.0	79	14.4	30	4.1	39	4.0
31	13.1	80	14.5	31	4.2	40	4.1
32	13.2	81	14.6	32	4.3	41	4.2
33	13.3	82	14.7	33	4.4	42	4.3
34	13.4	83	14.8	34	4.5	43	4.4
35	13.5	84	14.9	35	4.6	44	4.5
36	13.6	85	15.0	36	4.7	45	4.6
37	13.7	86	15.1	37	4.8	46	4.7
38	13.8	87	15.2	38	4.9	47	4.8
39	13.9	88	15.3	39	5.0	48	4.9
40	14.0	89	15.4	40	5.1	49	5.0
41	14.1	90	15.5	41	5.2	50	5.1
42	14.2	91	15.6	42	5.3	51	5.2
43	14.3	92	15.7	43	5.4	52	5.3
44	14.4	93	15.8	44	5.5	53	5.4
45	14.5	94	15.9	45	5.6	54	5.5
46	14.6	95	16.0	46	5.7	55	5.6
47	14.7	96	16.1	47	5.8	56	5.7
48	14.8	97	16.2	48	5.9	57	5.8
49	14.9	98	16.3	49	6.0	58	5.9
50	15.0	99	16.4	50	6.1	59	6.0
51	15.1	100	16.5	51	6.2	60	6.1

Table XIV

## TAPE CONTACT DISTANCES (mm) FOR TAPE No. 13

No.	DISTANCE	No.	DISTANCE	No.	DISTANCE	No.	DISTANCE
101	3.7	118	4.0	134	16.8	150	1.2
102	1.1	119	8.3	135	4.9	151	2.1
103	8.8	120	2.0	136	16.3	152	5.7
104	11.7	121	9.7	137	2.9	153	1.3
105	3.8	122	2.8	138	8.7	154	6.8
106	12.9	123	3.5	139	2.7	155	2.6
107	1.7	124	2.0	140	2.0	156	2.1
108	3.3	125	3.2	141	1.4	157	1.7
109	2.8	126	5.8	142	2.7	158	2.5
110	2.4	127	1.8	143	1.0	159	5.4
111	1.0	128	2.6	144	4.2	160	.9
112	.6	129	5.0	145	4.9	161	3.8
113	4.7	130	5.2	146	7.3	162	2.0
114	2.2	131	15.0	147	7.3	163	1.0
115	8.0	132	6.8	148	1.4	164	3.6
116	13.5	133	1.2	149	2.8	165	1.5
117	13.5						



Table XV

TAPE CONTACT DISTANCES (mm) FOR TAPE No. 14

No.	DISTANCE	No.	DISTANCE	No.	DISTANCE	No.	DISTANCE
1	2.2	26	12.9	51	3.0	76	22.3
2	4.6	27	57.3	52	3.4	77	30.0
3	5.0	28	18.0	53	18.0	78	3.9
4	14.8	29	7.3	54	1.4	79	4.0
5	9.2	30	13.8	55	8.0	80	4.9
6	7.6	31	4.8	56	2.7	81	13.2
7	1.8	32	2.9	57	7.3	82	8.5
8	1.9	33	7.0	58	1.2	83	15.4
9	15.0	34	2.0	59	3.9	84	4.0
10	6.9	35	1.8	60	5.2	85	1.8
11	4.7	36	4.8	61	7.2	86	7.7
12	3.0	37	3.9	62	8.4	87	6.7
13	.7	38	1.8	63	5.1	88	7.0
14	3.1	39	3.6	64	16.3	89	1.0
15	7.4	40	3.9	65	22.9	90	11.5
16	15.5	41	1.3	66	37.4	91	6.9
17	2.9	42	10.0	67	5.1	92	7.0
18	15.7	43	35.7	68	4.5	93	6.4
19	9.2	44	4.2	69	2.9	94	8.0
20	5.0	45	3.1	70	8.8	95	8.0
21	27.0	46	4.1	71	2.0	96	1.6
22	15.8	47	3.3	72	11.2	97	2.1
23	42.0	48	3.5	73	8.9	98	12.1
24	3.0	49	8.0	74	6.3	99	2.5
25	10.0	50	3.8	75	7.0	100	7.0



Table XV

TABLE CONTAINING DISTANCES (MILES) FOR TRIP NO. 14

STATION	NO.	DISTANCE	NO.	DISTANCE	NO.	DISTANCE	NO.	DISTANCE
1	20	1.0	21	1.0	22	1.0	23	1.0
2	24	1.0	25	1.0	26	1.0	27	1.0
3	28	1.0	29	1.0	30	1.0	31	1.0
4	32	1.0	33	1.0	34	1.0	35	1.0
5	36	1.0	37	1.0	38	1.0	39	1.0
6	40	1.0	41	1.0	42	1.0	43	1.0
7	44	1.0	45	1.0	46	1.0	47	1.0
8	48	1.0	49	1.0	50	1.0	51	1.0
9	52	1.0	53	1.0	54	1.0	55	1.0
10	56	1.0	57	1.0	58	1.0	59	1.0
11	60	1.0	61	1.0	62	1.0	63	1.0
12	64	1.0	65	1.0	66	1.0	67	1.0
13	68	1.0	69	1.0	70	1.0	71	1.0
14	72	1.0	73	1.0	74	1.0	75	1.0
15	76	1.0	77	1.0	78	1.0	79	1.0
16	80	1.0	81	1.0	82	1.0	83	1.0
17	84	1.0	85	1.0	86	1.0	87	1.0
18	88	1.0	89	1.0	90	1.0	91	1.0
19	92	1.0	93	1.0	94	1.0	95	1.0
20	96	1.0	97	1.0	98	1.0	99	1.0
21	100	1.0	101	1.0	102	1.0	103	1.0
22	104	1.0	105	1.0	106	1.0	107	1.0
23	108	1.0	109	1.0	110	1.0	111	1.0
24	112	1.0	113	1.0	114	1.0	115	1.0
25	116	1.0	117	1.0	118	1.0	119	1.0
26	120	1.0	121	1.0	122	1.0	123	1.0
27	124	1.0	125	1.0	126	1.0	127	1.0
28	128	1.0	129	1.0	130	1.0	131	1.0
29	132	1.0	133	1.0	134	1.0	135	1.0
30	136	1.0	137	1.0	138	1.0	139	1.0
31	140	1.0	141	1.0	142	1.0	143	1.0
32	144	1.0	145	1.0	146	1.0	147	1.0
33	148	1.0	149	1.0	150	1.0	151	1.0
34	152	1.0	153	1.0	154	1.0	155	1.0
35	156	1.0	157	1.0	158	1.0	159	1.0
36	160	1.0	161	1.0	162	1.0	163	1.0
37	164	1.0	165	1.0	166	1.0	167	1.0
38	168	1.0	169	1.0	170	1.0	171	1.0
39	172	1.0	173	1.0	174	1.0	175	1.0
40	176	1.0	177	1.0	178	1.0	179	1.0
41	180	1.0	181	1.0	182	1.0	183	1.0
42	184	1.0	185	1.0	186	1.0	187	1.0
43	188	1.0	189	1.0	190	1.0	191	1.0
44	192	1.0	193	1.0	194	1.0	195	1.0
45	196	1.0	197	1.0	198	1.0	199	1.0
46	200	1.0	201	1.0	202	1.0	203	1.0
47	204	1.0	205	1.0	206	1.0	207	1.0
48	208	1.0	209	1.0	210	1.0	211	1.0
49	212	1.0	213	1.0	214	1.0	215	1.0
50	216	1.0	217	1.0	218	1.0	219	1.0
51	220	1.0	221	1.0	222	1.0	223	1.0
52	224	1.0	225	1.0	226	1.0	227	1.0
53	228	1.0	229	1.0	230	1.0	231	1.0
54	232	1.0	233	1.0	234	1.0	235	1.0
55	236	1.0	237	1.0	238	1.0	239	1.0
56	240	1.0	241	1.0	242	1.0	243	1.0
57	244	1.0	245	1.0	246	1.0	247	1.0
58	248	1.0	249	1.0	250	1.0	251	1.0
59	252	1.0	253	1.0	254	1.0	255	1.0
60	256	1.0	257	1.0	258	1.0	259	1.0
61	260	1.0	261	1.0	262	1.0	263	1.0
62	264	1.0	265	1.0	266	1.0	267	1.0
63	268	1.0	269	1.0	270	1.0	271	1.0
64	272	1.0	273	1.0	274	1.0	275	1.0
65	276	1.0	277	1.0	278	1.0	279	1.0
66	280	1.0	281	1.0	282	1.0	283	1.0
67	284	1.0	285	1.0	286	1.0	287	1.0
68	288	1.0	289	1.0	290	1.0	291	1.0
69	292	1.0	293	1.0	294	1.0	295	1.0
70	296	1.0	297	1.0	298	1.0	299	1.0
71	300	1.0	301	1.0	302	1.0	303	1.0
72	304	1.0	305	1.0	306	1.0	307	1.0
73	308	1.0	309	1.0	310	1.0	311	1.0
74	312	1.0	313	1.0	314	1.0	315	1.0
75	316	1.0	317	1.0	318	1.0	319	1.0
76	320	1.0	321	1.0	322	1.0	323	1.0
77	324	1.0	325	1.0	326	1.0	327	1.0
78	328	1.0	329	1.0	330	1.0	331	1.0
79	332	1.0	333	1.0	334	1.0	335	1.0
80	336	1.0	337	1.0	338	1.0	339	1.0
81	340	1.0	341	1.0	342	1.0	343	1.0
82	344	1.0	345	1.0	346	1.0	347	1.0
83	348	1.0	349	1.0	350	1.0	351	1.0
84	352	1.0	353	1.0	354	1.0	355	1.0
85	356	1.0	357	1.0	358	1.0	359	1.0
86	360	1.0	361	1.0	362	1.0	363	1.0
87	364	1.0	365	1.0	366	1.0	367	1.0
88	368	1.0	369	1.0	370	1.0	371	1.0
89	372	1.0	373	1.0	374	1.0	375	1.0
90	376	1.0	377	1.0	378	1.0	379	1.0
91	380	1.0	381	1.0	382	1.0	383	1.0
92	384	1.0	385	1.0	386	1.0	387	1.0
93	388	1.0	389	1.0	390	1.0	391	1.0
94	392	1.0	393	1.0	394	1.0	395	1.0
95	396	1.0	397	1.0	398	1.0	399	1.0
96	400	1.0	401	1.0	402	1.0	403	1.0
97	404	1.0	405	1.0	406	1.0	407	1.0
98	408	1.0	409	1.0	410	1.0	411	1.0
99	412	1.0	413	1.0	414	1.0	415	1.0
100	416	1.0	417	1.0	418	1.0	419	1.0
101	420	1.0	421	1.0	422	1.0	423	1.0
102	424	1.0	425	1.0	426	1.0	427	1.0
103	428	1.0	429	1.0	430	1.0	431	1.0
104	432	1.0	433	1.0	434	1.0	435	1.0
105	436	1.0	437	1.0	438	1.0	439	1.0
106	440	1.0	441	1.0	442	1.0	443	1.0
107	444	1.0	445	1.0	446	1.0	447	1.0
108	448	1.0	449	1.0	450	1.0	451	1.0
109	452	1.0	453	1.0	454	1.0	455	1.0
110	456	1.0	457	1.0	458	1.0	459	1.0
111	460	1.0	461	1.0	462	1.0	463	1.0
112	464	1.0	465	1.0	466	1.0	467	1.0
113	468	1.0	469	1.0	470	1.0	471	1.0
114	472	1.0	473	1.0	474	1.0	475	1.0
115	476	1.0	477	1.0	478	1.0	479	1.0
116	480	1.0	481	1.0	482	1.0	483	1.0
117	484	1.0	485	1.0	486	1.0	487	1.0
118	488	1.0	489	1.0	490	1.0	491	1.0
119	492	1.0	493	1.0	494	1.0	495	1.0
120	496	1.0	497	1.0	498	1.0	499	1.0
121	500	1.0	501	1.0	502	1.0	503	1.0
122	504	1.0	505	1.0	506	1.0	507	1.0
123	508	1.0	509	1.0	510	1.0	511	1.0
124	512	1.0	513	1.0	514	1.0	515	1.0
125	516	1.0	517	1.0	518	1.0	519	1.0
126	520	1.0	521	1.0	522	1.0	523	1.0
127	524	1.0	525	1.0	526	1.0	527	1.0
128	528	1.0	529	1.0	530	1.0	531	1.0
129	532	1.0	533	1.0	534	1.0	535	1.0
130	536	1.0	537	1.0	538	1.0	539	1.0
131	540	1.0	541	1.0	542	1.0	543	1.0
132	544	1.0	545	1.0	546	1.0	547	1.0
133	548	1.0	549	1.0	550	1.0	551	1.0
134	552	1.0	553	1.0	554	1.0	555	1.0
135	556	1.0	557	1.0	558	1.0	559	1.0
136	560	1.0	561	1.0	562	1.0	563	1.0
137	564	1.0	565	1.0	566	1.0	567	1.0
138	568	1.0	569	1.0	570	1.0	571	1.0
139	572	1.0	573	1.0	574	1.0	575	1.0
140	576	1.0	577	1.0	578	1.0	579	1.0
141	580	1.0	581	1.0	582	1.0	583	1.0
142	584	1.0	585	1.0	586	1.0	587	1.0
143	588	1.0	589	1.0	590	1.0	591	1.0
144	592	1.0	593	1.0	594	1.0	595	1.0
145	596	1.0	597	1.0	598	1.0	599	1.0
146	600	1.0	601	1.0	602	1.0	603	1.0
147	604	1.0	605	1.0	606	1.0	607	1.0
148	608	1.0	609	1.0	610	1.0	611	1.0
149	612	1.0	613	1.0	614	1.0	615	1.0
150	616	1.0	617	1.0	618	1.0	619	1.0
151	620	1.0	621	1.0	622	1.0	623	1.0
152	624	1.0	625	1.0	626	1.0	627	1.0
153	628	1.0	629	1.0	630	1.0	631	1.0
154	632	1.0	633	1.0	634	1.0	635	1.0
155	636	1.0	637	1.0	638	1.0	639	1.0
156	640	1.0	641	1.0	642	1.0	643	1.0
157	644	1.0	645	1.0	646	1.0	647	1.0
158	648	1.0	649	1.0	650	1.0	651	1.0
159	652	1.0	653	1.0	654	1.0	655	1.0
160	656	1.0	657	1.0	658	1.0	659	1.0
161	660	1.0	661	1.0	662	1.0	663	1.0
162	664	1.0	665	1.0	666	1.0	667	1.0
163	668	1.0	669	1.0	67			

Table XV

TAPE CONTACT DISTANCES (mm) FOR TAPE No. 14

No.	DISTANCE	No.	DISTANCE	No.	DISTANCE	No.	DISTANCE
101	3.2	119	5.0	136	4.5	153	10.2
102	1.8	120	4.1	137	6.6	154	6.5
103	9.5	121	8.5	138	2.9	155	4.4
104	9.9	122	5.2	139	13.2	156	3.2
105	5.0	123	26.5	140	1.8	157	3.4
106	7.9	124	6.0	141	2.9	158	3.0
107	10.0	125	18.0	142	22.9	159	8.9
108	3.2	126	15.5	143	3.5	160	9.0
109	10.9	127	3.3	144	4.3	161	27.9
110	14.9	128	9.8	145	1.1	162	7.0
111	8.6	129	1.2	146	12.9	163	3.0
112	37.6	130	6.0	147	14.8	164	1.7
113	11.5	131	10.8	148	2.0	165	4.3
114	49.9	132	4.9	149	6.1	166	3.1
115	9.5	133	3.0	150	2.1	167	3.9
116	14.8	134	3.6	151	47.6	168	40.1
117	8.0	135	4.0	152	10.0	169	4.1
118	12.3						

Table 13

TAPE CORRECT DISTANCES (m) FOR WAVE NO. 14

NO.	DISTANCE	NO.	DISTANCE	NO.	DISTANCE	NO.	DISTANCE
101	3.5	119	3.0	137	0.5	155	10.5
102	1.5	120	0.1	138	0.0	156	0.0
103	0.5	121	0.5	139	0.0	157	0.0
104	0.0	122	0.5	140	13.5	158	3.5
105	0.0	123	0.5	141	0.0	159	3.0
106	1.5	124	0.0	142	0.0	160	0.0
107	10.0	125	10.0	143	0.0	161	0.0
108	3.5	126	1.5	144	0.0	162	0.0
109	10.0	127	0.0	145	0.0	163	0.0
110	1.0	128	0.0	146	1.0	164	1.0
111	0.0	129	1.5	147	15.0	165	2.0
112	10.0	130	0.0	148	10.0	166	1.0
113	11.0	131	10.0	149	0.0	167	0.0
114	0.0	132	0.0	150	0.0	168	0.0
115	0.0	133	0.0	151	0.0	169	0.0
116	10.0	134	0.0	152	0.0	170	0.0
117	0.0	135	0.0	153	0.0	171	0.0
118	15.0	136	0.0	154	0.0	172	0.0
119	0.0	137	0.0	155	0.0	173	0.0
120	0.0	138	0.0	156	0.0	174	0.0
121	0.0	139	0.0	157	0.0	175	0.0
122	0.0	140	0.0	158	0.0	176	0.0
123	0.0	141	0.0	159	0.0	177	0.0
124	0.0	142	0.0	160	0.0	178	0.0
125	0.0	143	0.0	161	0.0	179	0.0
126	0.0	144	0.0	162	0.0	180	0.0
127	0.0	145	0.0	163	0.0	181	0.0
128	0.0	146	0.0	164	0.0	182	0.0
129	0.0	147	0.0	165	0.0	183	0.0
130	0.0	148	0.0	166	0.0	184	0.0
131	0.0	149	0.0	167	0.0	185	0.0
132	0.0	150	0.0	168	0.0	186	0.0
133	0.0	151	0.0	169	0.0	187	0.0
134	0.0	152	0.0	170	0.0	188	0.0
135	0.0	153	0.0	171	0.0	189	0.0
136	0.0	154	0.0	172	0.0	190	0.0
137	0.0	155	0.0	173	0.0	191	0.0
138	0.0	156	0.0	174	0.0	192	0.0
139	0.0	157	0.0	175	0.0	193	0.0
140	0.0	158	0.0	176	0.0	194	0.0
141	0.0	159	0.0	177	0.0	195	0.0
142	0.0	160	0.0	178	0.0	196	0.0
143	0.0	161	0.0	179	0.0	197	0.0
144	0.0	162	0.0	180	0.0	198	0.0
145	0.0	163	0.0	181	0.0	199	0.0
146	0.0	164	0.0	182	0.0	200	0.0
147	0.0	165	0.0	183	0.0	201	0.0
148	0.0	166	0.0	184	0.0	202	0.0
149	0.0	167	0.0	185	0.0	203	0.0
150	0.0	168	0.0	186	0.0	204	0.0
151	0.0	169	0.0	187	0.0	205	0.0
152	0.0	170	0.0	188	0.0	206	0.0
153	0.0	171	0.0	189	0.0	207	0.0
154	0.0	172	0.0	190	0.0	208	0.0
155	0.0	173	0.0	191	0.0	209	0.0
156	0.0	174	0.0	192	0.0	210	0.0
157	0.0	175	0.0	193	0.0	211	0.0
158	0.0	176	0.0	194	0.0	212	0.0
159	0.0	177	0.0	195	0.0	213	0.0
160	0.0	178	0.0	196	0.0	214	0.0
161	0.0	179	0.0	197	0.0	215	0.0
162	0.0	180	0.0	198	0.0	216	0.0
163	0.0	181	0.0	199	0.0	217	0.0
164	0.0	182	0.0	200	0.0	218	0.0
165	0.0	183	0.0	201	0.0	219	0.0
166	0.0	184	0.0	202	0.0	220	0.0
167	0.0	185	0.0	203	0.0	221	0.0
168	0.0	186	0.0	204	0.0	222	0.0
169	0.0	187	0.0	205	0.0	223	0.0
170	0.0	188	0.0	206	0.0	224	0.0
171	0.0	189	0.0	207	0.0	225	0.0
172	0.0	190	0.0	208	0.0	226	0.0
173	0.0	191	0.0	209	0.0	227	0.0
174	0.0	192	0.0	210	0.0	228	0.0
175	0.0	193	0.0	211	0.0	229	0.0
176	0.0	194	0.0	212	0.0	230	0.0
177	0.0	195	0.0	213	0.0	231	0.0
178	0.0	196	0.0	214	0.0	232	0.0
179	0.0	197	0.0	215	0.0	233	0.0
180	0.0	198	0.0	216	0.0	234	0.0
181	0.0	199	0.0	217	0.0	235	0.0
182	0.0	200	0.0	218	0.0	236	0.0
183	0.0	201	0.0	219	0.0	237	0.0
184	0.0	202	0.0	220	0.0	238	0.0
185	0.0	203	0.0	221	0.0	239	0.0
186	0.0	204	0.0	222	0.0	240	0.0
187	0.0	205	0.0	223	0.0	241	0.0
188	0.0	206	0.0	224	0.0	242	0.0
189	0.0	207	0.0	225	0.0	243	0.0
190	0.0	208	0.0	226	0.0	244	0.0
191	0.0	209	0.0	227	0.0	245	0.0
192	0.0	210	0.0	228	0.0	246	0.0
193	0.0	211	0.0	229	0.0	247	0.0
194	0.0	212	0.0	230	0.0	248	0.0
195	0.0	213	0.0	231	0.0	249	0.0
196	0.0	214	0.0	232	0.0	250	0.0
197	0.0	215	0.0	233	0.0	251	0.0
198	0.0	216	0.0	234	0.0	252	0.0
199	0.0	217	0.0	235	0.0	253	0.0
200	0.0	218	0.0	236	0.0	254	0.0
201	0.0	219	0.0	237	0.0	255	0.0
202	0.0	220	0.0	238	0.0	256	0.0
203	0.0	221	0.0	239	0.0	257	0.0
204	0.0	222	0.0	240	0.0	258	0.0
205	0.0	223	0.0	241	0.0	259	0.0
206	0.0	224	0.0	242	0.0	260	0.0
207	0.0	225	0.0	243	0.0	261	0.0
208	0.0	226	0.0	244	0.0	262	0.0
209	0.0	227	0.0	245	0.0	263	0.0
210	0.0	228	0.0	246	0.0	264	0.0
211	0.0	229	0.0	247	0.0	265	0.0
212	0.0	230	0.0	248	0.0	266	0.0
213	0.0	231	0.0	249	0.0	267	0.0
214	0.0	232	0.0	250	0.0	268	0.0
215	0.0	233	0.0	251	0.0	269	0.0
216	0.0	234	0.0	252	0.0	270	0.0
217	0.0	235	0.0	253	0.0	271	0.0
218	0.0	236	0.0	254	0.0	272	0.0
219	0.0	237	0.0	255	0.0	273	0.0
220	0.0	238	0.0	256	0.0	274	0.0
221	0.0	239	0.0	257	0.0	275	0.0
222	0.0	240	0.0	258	0.0	276	0.0
223	0.0	241	0.0	259	0.0	277	0.0
224	0.0	242	0.0	260	0.0	278	0.0
225	0.0	243	0.0	261	0.0	279	0.0
226	0.0	244	0.0	262	0.0	280	0.0
227	0.0	245	0.0	263	0.0	281	0.0
228	0.0	246	0.0	264	0.0	282	0.0
229	0.0	247	0.0	265	0.0	283	0.0
230	0.0	248	0.0	266	0.0	284	0.0
231	0.0	249	0.0	267	0.0	285	0.0
232	0.0	250	0.0	268	0.0	286	0.0
233	0.0	251	0.0	269	0.0	287	0.0
234	0.0	252	0.0	270	0.0	288	0.0
235	0.0	253	0.0	271	0.0	289	0.0
236	0.0	254	0.0	272	0.0	290	0.0
237	0.0	255	0.0	273	0.0	291	0.0
238	0.0	256	0.0	274	0.0	292	0.0
239	0.0	257	0.0	275	0.0	293	0.0
240	0.0	258	0.0	276	0.0	294	0.0
241	0.0	259	0.0	277	0.0	295	0.0
242	0.0	260	0.0	278	0.0	296	0.0
243	0.0	261	0.0	279	0.0	297	0.0
244	0.0	262	0.0	280	0.0	298	0.0
245	0.0	263	0.0	281	0.0	299	0.0
246	0.0	264	0.0	282	0.0	300	0.0
247	0.0	265	0.0	283	0.0	301	0.0
248	0.0	266	0.0	284	0.0	302	0.0
249	0.0	267	0.0	285	0.0	303	0.0
250	0.0	268	0.0	286	0.0	304	0.0
251	0.0	269	0.0	287	0.0	305	0.0
252	0.0	270	0.0	288	0.0	306	0.0
253	0.0	271	0.0	289	0.0	307	0.0
254	0.0	272	0.0	290	0.0	308	0.0
255	0.0	273	0.0	291	0.0	309	0.0
256	0.0	274	0.0	292	0.0	310	0.0
257	0.0	275	0.0	293	0.0	311	0.0
258	0.0	276	0.0	294	0.0	312	0.0
259	0.0	277	0.0	295	0.0	313	0.0
260	0.0	278	0.0	296	0.0	314	0.0
261	0.0	279	0.0	297	0.0	315	0.0
262	0.0	280	0.0	298	0.0	316	0.0
263	0.0	281	0.0	299	0.0	317	0.0
264	0.0	282	0.0	300	0.0	318	0.0
265	0.0	283	0.0	301	0.0	319	0.0
266	0.0	284	0.0	302	0.0	320	0.0
267	0.0	285	0.0	303	0.0	321	0.0
268	0.0	286	0.0	304	0.0	322	0.0
269	0.0	287	0.0	305	0.0	323	0.0
270	0.0	288	0.0	306	0.0	324	0.0
271	0.0	289	0.0	307	0.0	325	0.0
272	0.0	290	0.0	308	0.0	326	0.0
273	0.0	291	0.0	309	0.0	327	0.0
274	0.0	292	0.0	310	0.0	328	0.0
275	0.0	293	0.0	311	0.0	329	0.0
276	0.0	294	0.0	312	0.0	330	0.0
277	0.0	295	0.0	313	0.0	331	0.0
278	0.0	296	0.0	314	0.0	332	0.0
279	0.0	297	0.0	315	0.0	333	0.0

Table XVI

## TAPE CONTACT DISTANCES (mm) FOR TAPE No. 15

No.	DISTANCE	No.	DISTANCE	No.	DISTANCE	No.	DISTANCE
1	5.1	26	4.7	51	9.0	76	25.0
2	5.0	27	3.5	52	7.0	77	8.3
3	4.0	28	5.0	53	16.8	78	19.2
4	1.4	29	11.3	54	11.5	79	2.6
5	2.2	30	8.3	55	1.2	80	3.5
6	9.3	31	6.1	56	2.0	81	.6
7	5.0	32	33.0	57	8.2	82	2.5
8	18.8	33	8.0	58	3.6	83	1.0
9	3.0	34	1.3	59	45.0	84	2.0
10	4.8	35	7.0	60	23.3	85	21.8
11	6.1	36	7.0	61	20.9	86	6.9
12	4.7	37	5.1	62	17.6	87	2.0
13	28.7	38	1.4	63	7.5	88	56.5
14	5.2	39	8.4	64	6.5	89	9.9
15	4.7	40	5.5	65	4.6	90	10.3
16	2.7	41	5.2	66	11.5	91	14.0
17	9.0	42	3.9	67	8.0	92	8.6
18	3.2	43	17.0	68	11.2	93	21.6
19	1.1	44	9.0	69	11.0	94	18.7
20	25.3	45	37.3	70	24.7	95	8.8
21	8.4	46	14.0	71	6.7	96	5.6
22	2.0	47	5.3	72	10.3	97	6.5
23	5.4	48	5.5	73	7.4	98	2.5
24	4.7	49	6.0	74	15.1	99	6.0
25	7.0	50	2.2	75	7.3	100	3.3



Table XVI

WATER CONTENT DISTANCE (m) FOR THIS NO. 11

NO.	DISTANCE	NO.	DISTANCE	NO.	DISTANCE	NO.	DISTANCE
1	2.1	26	4.1	51	1.0	76	2.2
2	2.0	27	3.2	52	1.0	77	2.2
3	4.0	28	1.0	53	12.8	78	12.8
4	1.1	29	11.2	54	11.2	79	5.0
5	2.2	30	4.2	55	2.2	80	2.2
6	2.2	31	0.1	56	2.0	81	0
7	2.0	32	22.0	57	0.2	82	2.2
8	12.8	33	4.0	58	2.0	83	1.0
9	2.0	34	1.2	59	22.0	84	2.0
10	4.0	35	2.0	60	22.2	85	21.2
11	0.1	36	2.0	61	20.2	86	0.0
12	4.2	37	2.1	62	12.8	87	0.0
13	22.1	38	1.2	63	2.2	88	20.2
14	2.2	39	2.2	64	0.2	89	2.2
15	2.2	40	2.2	65	4.0	90	20.2
16	2.2	41	2.2	66	11.2	91	12.0
17	0.2	42	2.2	67	5.0	92	4.2
18	2.2	43	12.0	68	11.2	93	21.2
19	1.2	44	2.0	69	11.0	94	20.2
20	22.2	45	21.2	70	22.2	95	4.2
21	4.2	46	10.0	71	0.2	96	2.0
22	2.0	47	2.2	72	22.2	97	0.2
23	0.2	48	2.2	73	2.2	98	2.2
24	2.1	49	0.2	74	2.2	99	0.0
25	2.0	50	4.2	75	1.2	100	1.2

Table XVI

## TAPE CONTACT DISTANCES (mm) FOR TAPE No. 15

No.	DISTANCE	No.	DISTANCE	No.	DISTANCE	No.	DISTANCE
101	4.6	111	4.7	121	9.5	131	18.2
102	32.6	112	5.3	122	5.3	132	40.0
103	88.4	113	47.2	123	7.1	133	40.9
104	2.0	114	8.6	124	4.0	134	5.0
105	5.1	115	10.0	125	10.4	135	28.5
106	3.9	116	2.2	126	20.0	136	13.2
107	5.5	117	10.8	127	84.4	137	10.2
108	5.4	118	4.7	128	22.5	138	13.3
109	18.8	119	18.3	129	9.0	139	5.4
110	10.5	120	8.0	130	5.0	140	12.5

Table VI

THE CONTACT DISTANCE (mm) FOR EACH NO. 12

NO.	DISTANCE	NO.	DISTANCE	NO.	DISTANCE	NO.	DISTANCE
101	111	111	111	121	111	131	111
102	112	112	112	122	112	132	112
103	113	113	113	123	113	133	113
104	114	114	114	124	114	134	114
105	115	115	115	125	115	135	115
106	116	116	116	126	116	136	116
107	117	117	117	127	117	137	117
108	118	118	118	128	118	138	118
109	119	119	119	129	119	139	119
110	120	120	120	130	120	140	120
111	121	121	121	141	121	151	121
112	122	122	122	152	122	162	122
113	123	123	123	163	123	173	123
114	124	124	124	174	124	184	124
115	125	125	125	185	125	195	125
116	126	126	126	196	126	206	126
117	127	127	127	207	127	217	127
118	128	128	128	218	128	228	128
119	129	129	129	229	129	239	129
120	130	130	130	240	130	250	130
121	131	131	131	251	131	261	131
122	132	132	132	262	132	272	132
123	133	133	133	273	133	283	133
124	134	134	134	284	134	294	134
125	135	135	135	295	135	305	135
126	136	136	136	306	136	316	136
127	137	137	137	317	137	327	137
128	138	138	138	328	138	338	138
129	139	139	139	339	139	349	139
130	140	140	140	350	140	360	140
131	141	141	141	361	141	371	141
132	142	142	142	372	142	382	142
133	143	143	143	383	143	393	143
134	144	144	144	394	144	404	144
135	145	145	145	405	145	415	145
136	146	146	146	416	146	426	146
137	147	147	147	427	147	437	147
138	148	148	148	438	148	448	148
139	149	149	149	449	149	459	149
140	150	150	150	460	150	470	150
141	151	151	151	471	151	481	151
142	152	152	152	482	152	492	152
143	153	153	153	493	153	503	153
144	154	154	154	504	154	514	154
145	155	155	155	515	155	525	155
146	156	156	156	526	156	536	156
147	157	157	157	537	157	547	157
148	158	158	158	548	158	558	158
149	159	159	159	559	159	569	159
150	160	160	160	570	160	580	160
151	161	161	161	581	161	591	161
152	162	162	162	592	162	602	162
153	163	163	163	603	163	613	163
154	164	164	164	614	164	624	164
155	165	165	165	625	165	635	165
156	166	166	166	636	166	646	166
157	167	167	167	647	167	657	167
158	168	168	168	658	168	668	168
159	169	169	169	669	169	679	169
160	170	170	170	680	170	690	170
161	171	171	171	691	171	701	171
162	172	172	172	702	172	712	172
163	173	173	173	713	173	723	173
164	174	174	174	724	174	734	174
165	175	175	175	735	175	745	175
166	176	176	176	746	176	756	176
167	177	177	177	757	177	767	177
168	178	178	178	768	178	778	178
169	179	179	179	779	179	789	179
170	180	180	180	790	180	800	180
171	181	181	181	801	181	811	181
172	182	182	182	812	182	822	182
173	183	183	183	823	183	833	183
174	184	184	184	834	184	844	184
175	185	185	185	845	185	855	185
176	186	186	186	856	186	866	186
177	187	187	187	867	187	877	187
178	188	188	188	878	188	888	188
179	189	189	189	889	189	899	189
180	190	190	190	900	190	910	190
181	191	191	191	911	191	921	191
182	192	192	192	922	192	932	192
183	193	193	193	933	193	943	193
184	194	194	194	944	194	954	194
185	195	195	195	955	195	965	195
186	196	196	196	966	196	976	196
187	197	197	197	977	197	987	197
188	198	198	198	988	198	998	198
189	199	199	199	999	199	1000	199
190	200	200	200	1000	200		

Table XVII

TAPE CONTACT DISTANCES (mm) FOR TAPE No. 16

No.	DISTANCE	No.	DISTANCE	No.	DISTANCE	No.	DISTANCE
1	2.7	12	2.4	23	24.9	33	15.0
2	10.0	13	1.5	24	21.0	34	7.7
3	5.3	14	4.5	25	4.5	35	7.4
4	6.3	15	5.0	26	2.6	36	2.0
5	1.6	16	8.1	27	25.8	37	5.3
6	2.9	17	8.9	28	6.2	38	4.5
7	3.0	18	3.2	29	4.0	39	11.6
8	7.9	19	2.9	30	15.5	40	8.6
9	4.6	20	3.5	31	5.8	41	56.8
10	7.9	21	3.5	32	6.0	42	15.6
11	15.7	22	4.0				



Table 2

es „soziale Werte (z.B.)“ extrahiert. Folgende Werte

[illegible]

Table XVIII

## TAPE CONTACT DISTANCES (mm) FOR TAPE No. 17

No.	DISTANCE	No.	DISTANCE	No.	DISTANCE	No.	DISTANCE
1	2.6	26	5.8	51	4.1	76	10.2
2	3.3	27	8.1	52	10.9	77	8.9
3	.5	28	6.0	53	5.6	78	2.1
4	34.7	29	4.0	54	2.4	79	5.8
5	5.7	30	2.3	55	3.7	80	2.1
6	12.1	31	3.7	56	8.8	81	1.7
7	4.5	32	3.9	57	7.4	82	8.8
8	1.9	33	5.1	58	8.5	83	3.3
9	3.8	34	22.9	59	4.0	84	5.0
10	3.7	35	11.8	60	6.3	85	.5
11	4.3	36	9.0	61	4.2	86	3.3
12	.8	37	2.3	62	10.5	87	5.4
13	21.0	38	2.0	63	4.7	88	4.7
14	10.8	39	.5	64	2.3	89	7.0
15	24.9	40	3.8	65	3.7	90	4.9
16	5.5	41	2.5	66	11.0	91	3.8
17	2.7	42	1.9	67	2.1	92	6.9
18	2.4	43	1.0	68	9.0	93	9.2
19	2.8	44	12.3	69	3.5	94	6.2
20	1.2	45	2.8	70	4.1	95	2.2
21	5.7	46	8.8	71	1.8	96	7.1
22	3.6	47	2.2	72	1.0	97	5.6
23	8.8	48	2.8	73	2.2	98	3.4
24	2.0	49	8.3	74	9.9	99	27.7
25	2.7	50	2.0	75	10.3	100	20.4

# TABLE VIII

TABLE OF CONTACT DISTANCES (MILES) FOR YEAR 1911

NO.	DISTANCE	NO.	DISTANCE	NO.	DISTANCE	NO.	DISTANCE
1	1.0	25	2.5	49	1.0	73	1.0
2	2.2	26	1.1	50	1.0	74	1.0
3	2.0	27	0.0	51	1.0	75	1.0
4	1.0	28	0.0	52	1.0	76	1.0
5	2.0	29	3.0	53	1.0	77	1.0
6	1.0	30	1.0	54	1.0	78	1.0
7	1.0	31	1.0	55	1.0	79	1.0
8	1.0	32	1.0	56	1.0	80	1.0
9	1.0	33	1.0	57	1.0	81	1.0
10	1.0	34	1.0	58	1.0	82	1.0
11	1.0	35	1.0	59	1.0	83	1.0
12	1.0	36	1.0	60	1.0	84	1.0
13	1.0	37	1.0	61	1.0	85	1.0
14	1.0	38	1.0	62	1.0	86	1.0
15	1.0	39	1.0	63	1.0	87	1.0
16	1.0	40	1.0	64	1.0	88	1.0
17	1.0	41	1.0	65	1.0	89	1.0
18	1.0	42	1.0	66	1.0	90	1.0
19	1.0	43	1.0	67	1.0	91	1.0
20	1.0	44	1.0	68	1.0	92	1.0
21	1.0	45	1.0	69	1.0	93	1.0
22	1.0	46	1.0	70	1.0	94	1.0
23	1.0	47	1.0	71	1.0	95	1.0
24	1.0	48	1.0	72	1.0	96	1.0
25	1.0	49	1.0	73	1.0	97	1.0
26	1.0	50	1.0	74	1.0	98	1.0
27	1.0	51	1.0	75	1.0	99	1.0
28	1.0	52	1.0	76	1.0	100	1.0
29	1.0	53	1.0	77	1.0		
30	1.0	54	1.0	78	1.0		
31	1.0	55	1.0	79	1.0		
32	1.0	56	1.0	80	1.0		
33	1.0	57	1.0	81	1.0		
34	1.0	58	1.0	82	1.0		
35	1.0	59	1.0	83	1.0		
36	1.0	60	1.0	84	1.0		
37	1.0	61	1.0	85	1.0		
38	1.0	62	1.0	86	1.0		
39	1.0	63	1.0	87	1.0		
40	1.0	64	1.0	88	1.0		
41	1.0	65	1.0	89	1.0		
42	1.0	66	1.0	90	1.0		
43	1.0	67	1.0	91	1.0		
44	1.0	68	1.0	92	1.0		
45	1.0	69	1.0	93	1.0		
46	1.0	70	1.0	94	1.0		
47	1.0	71	1.0	95	1.0		
48	1.0	72	1.0	96	1.0		
49	1.0	73	1.0	97	1.0		
50	1.0	74	1.0	98	1.0		
51	1.0	75	1.0	99	1.0		
52	1.0	76	1.0	100	1.0		
53	1.0	77	1.0				
54	1.0	78	1.0				
55	1.0	79	1.0				
56	1.0	80	1.0				
57	1.0	81	1.0				
58	1.0	82	1.0				
59	1.0	83	1.0				
60	1.0	84	1.0				
61	1.0	85	1.0				
62	1.0	86	1.0				
63	1.0	87	1.0				
64	1.0	88	1.0				
65	1.0	89	1.0				
66	1.0	90	1.0				
67	1.0	91	1.0				
68	1.0	92	1.0				
69	1.0	93	1.0				
70	1.0	94	1.0				
71	1.0	95	1.0				
72	1.0	96	1.0				
73	1.0	97	1.0				
74	1.0	98	1.0				
75	1.0	99	1.0				
76	1.0	100	1.0				

Table XVIII

## TAPE CONTACT DISTANCES (mm) FOR TAPE No. 17

No.	DISTANCE	No.	DISTANCE	No.	DISTANCE	No.	DISTANCE
101	7.0	126	3.7	151	38.0	176	29.3
102	5.5	127	2.6	152	2.5	177	36.5
103	7.0	128	2.0	153	15.3	178	17.1
104	31.9	129	2.8	154	17.3	179	2.3
105	5.7	130	2.8	155	4.0	180	5.3
106	3.9	131	4.6	156	4.6	181	7.2
107	2.0	132	2.2	157	8.8	182	2.4
108	4.2	133	3.9	158	1.0	183	3.5
109	24.8	134	4.3	159	7.0	184	2.0
110	5.5	135	2.4	160	6.0	185	12.4
111	6.0	136	2.1	161	3.7	186	2.4
112	8.3	137	9.3	162	7.9	187	8.2
113	11.9	138	9.5	163	1.8	188	4.0
114	12.0	139	3.9	164	2.1	189	3.4
115	3.5	140	5.0	165	1.2	190	14.2
116	5.4	141	12.2	166	7.0	191	5.3
117	6.9	142	5.0	167	5.7	192	3.0
118	4.1	143	.8	168	4.0	193	7.4
119	8.0	144	3.8	169	11.0	194	19.2
120	.7	145	5.9	170	5.6	195	2.4
121	5.0	146	2.4	171	110.7	196	4.4
122	.5	147	3.2	172	.5	197	2.5
123	5.9	148	11.9	173	21.6	198	2.0
124	.4	149	5.3	174	3.8	199	5.4
125	7.2	150	22.2	175	25.7	200	3.8



## TABLE XVII

TIDE CORRECTIONS (M) FOR TIME NO. 17

TIME	NO.	TIME	NO.	TIME	NO.	TIME	NO.
101	101	101	101	101	101	101	101
102	102	102	102	102	102	102	102
103	103	103	103	103	103	103	103
104	104	104	104	104	104	104	104
105	105	105	105	105	105	105	105
106	106	106	106	106	106	106	106
107	107	107	107	107	107	107	107
108	108	108	108	108	108	108	108
109	109	109	109	109	109	109	109
110	110	110	110	110	110	110	110
111	111	111	111	111	111	111	111
112	112	112	112	112	112	112	112
113	113	113	113	113	113	113	113
114	114	114	114	114	114	114	114
115	115	115	115	115	115	115	115
116	116	116	116	116	116	116	116
117	117	117	117	117	117	117	117
118	118	118	118	118	118	118	118
119	119	119	119	119	119	119	119
120	120	120	120	120	120	120	120
121	121	121	121	121	121	121	121
122	122	122	122	122	122	122	122
123	123	123	123	123	123	123	123
124	124	124	124	124	124	124	124
125	125	125	125	125	125	125	125
126	126	126	126	126	126	126	126
127	127	127	127	127	127	127	127
128	128	128	128	128	128	128	128
129	129	129	129	129	129	129	129
130	130	130	130	130	130	130	130
131	131	131	131	131	131	131	131
132	132	132	132	132	132	132	132
133	133	133	133	133	133	133	133
134	134	134	134	134	134	134	134
135	135	135	135	135	135	135	135
136	136	136	136	136	136	136	136
137	137	137	137	137	137	137	137
138	138	138	138	138	138	138	138
139	139	139	139	139	139	139	139
140	140	140	140	140	140	140	140
141	141	141	141	141	141	141	141
142	142	142	142	142	142	142	142
143	143	143	143	143	143	143	143
144	144	144	144	144	144	144	144
145	145	145	145	145	145	145	145
146	146	146	146	146	146	146	146
147	147	147	147	147	147	147	147
148	148	148	148	148	148	148	148
149	149	149	149	149	149	149	149
150	150	150	150	150	150	150	150

Table XVIII

## TAPE CONTACT DISTANCES (mm) FOR TAPE No. 17

No.	DISTANCE	No.	DISTANCE	No.	DISTANCE	No.	DISTANCE
201	5.6	220	22.6	239	6.0	258	4.0
202	3.9	221	2.1	240	4.0	259	4.0
203	8.9	222	2.4	241	5.7	260	.7
204	7.0	223	5.4	242	2.2	261	9.3
205	1.7	224	6.2	243	1.9	262	3.8
206	6.3	225	4.0	244	2.6	263	1.7
207	5.2	226	4.0	245	1.0	264	2.0
208	7.3	227	5.7	246	1.6	265	10.9
209	2.8	228	6.0	247	6.0	266	3.6
210	7.0	229	22.0	248	4.7	267	1.7
211	2.8	230	5.9	249	11.0	268	5.9
212	4.0	231	4.0	250	6.0	269	5.7
213	7.3	232	16.0	251	24.0	270	4.0
214	3.5	233	4.0	252	10.5	271	3.0
215	7.0	234	9.0	253	7.2	272	3.8
216	4.7	235	10.5	254	4.0	273	1.5
217	.8	236	10.7	255	2.7	274	3.7
218	8.3	237	4.3	256	3.5	275	8.8
219	27.6	238	5.6	257	3.8	276	.9

# TABLE 1

TABLE 1. CONTINUED. DISTANCE (mm) FOR EACH NO. 11

NO.	DISTANCE	NO.	DISTANCE	NO.	DISTANCE	NO.	DISTANCE
501	0.0	550	0.0	599	0.0	648	0.0
502	1.0	551	1.0	600	1.0	649	1.0
503	2.0	552	2.0	601	2.0	650	2.0
504	3.0	553	3.0	602	3.0	651	3.0
505	4.0	554	4.0	603	4.0	652	4.0
506	5.0	555	5.0	604	5.0	653	5.0
507	6.0	556	6.0	605	6.0	654	6.0
508	7.0	557	7.0	606	7.0	655	7.0
509	8.0	558	8.0	607	8.0	656	8.0
510	9.0	559	9.0	608	9.0	657	9.0
511	10.0	560	10.0	609	10.0	658	10.0
512	11.0	561	11.0	610	11.0	659	11.0
513	12.0	562	12.0	611	12.0	660	12.0
514	13.0	563	13.0	612	13.0	661	13.0
515	14.0	564	14.0	613	14.0	662	14.0
516	15.0	565	15.0	614	15.0	663	15.0
517	16.0	566	16.0	615	16.0	664	16.0
518	17.0	567	17.0	616	17.0	665	17.0
519	18.0	568	18.0	617	18.0	666	18.0
520	19.0	569	19.0	618	19.0	667	19.0
521	20.0	570	20.0	619	20.0	668	20.0
522	21.0	571	21.0	620	21.0	669	21.0
523	22.0	572	22.0	621	22.0	670	22.0
524	23.0	573	23.0	622	23.0	671	23.0
525	24.0	574	24.0	623	24.0	672	24.0
526	25.0	575	25.0	624	25.0	673	25.0
527	26.0	576	26.0	625	26.0	674	26.0
528	27.0	577	27.0	626	27.0	675	27.0
529	28.0	578	28.0	627	28.0	676	28.0
530	29.0	579	29.0	628	29.0	677	29.0
531	30.0	580	30.0	629	30.0	678	30.0
532	31.0	581	31.0	630	31.0	679	31.0
533	32.0	582	32.0	631	32.0	680	32.0
534	33.0	583	33.0	632	33.0	681	33.0
535	34.0	584	34.0	633	34.0	682	34.0
536	35.0	585	35.0	634	35.0	683	35.0
537	36.0	586	36.0	635	36.0	684	36.0
538	37.0	587	37.0	636	37.0	685	37.0
539	38.0	588	38.0	637	38.0	686	38.0
540	39.0	589	39.0	638	39.0	687	39.0
541	40.0	590	40.0	639	40.0	688	40.0
542	41.0	591	41.0	640	41.0	689	41.0
543	42.0	592	42.0	641	42.0	690	42.0
544	43.0	593	43.0	642	43.0	691	43.0
545	44.0	594	44.0	643	44.0	692	44.0
546	45.0	595	45.0	644	45.0	693	45.0
547	46.0	596	46.0	645	46.0	694	46.0
548	47.0	597	47.0	646	47.0	695	47.0
549	48.0	598	48.0	647	48.0	696	48.0
550	49.0	599	49.0	648	49.0	697	49.0
551	50.0	600	50.0	649	50.0	698	50.0
552	51.0	601	51.0	650	51.0	699	51.0
553	52.0	602	52.0	651	52.0	700	52.0
554	53.0	603	53.0	652	53.0	701	53.0
555	54.0	604	54.0	653	54.0	702	54.0
556	55.0	605	55.0	654	55.0	703	55.0
557	56.0	606	56.0	655	56.0	704	56.0
558	57.0	607	57.0	656	57.0	705	57.0
559	58.0	608	58.0	657	58.0	706	58.0
560	59.0	609	59.0	658	59.0	707	59.0
561	60.0	610	60.0	659	60.0	708	60.0
562	61.0	611	61.0	660	61.0	709	61.0
563	62.0	612	62.0	661	62.0	710	62.0
564	63.0	613	63.0	662	63.0	711	63.0
565	64.0	614	64.0	663	64.0	712	64.0
566	65.0	615	65.0	664	65.0	713	65.0
567	66.0	616	66.0	665	66.0	714	66.0
568	67.0	617	67.0	666	67.0	715	67.0
569	68.0	618	68.0	667	68.0	716	68.0
570	69.0	619	69.0	668	69.0	717	69.0
571	70.0	620	70.0	669	70.0	718	70.0
572	71.0	621	71.0	670	71.0	719	71.0
573	72.0	622	72.0	671	72.0	720	72.0
574	73.0	623	73.0	672	73.0	721	73.0
575	74.0	624	74.0	673	74.0	722	74.0
576	75.0	625	75.0	674	75.0	723	75.0
577	76.0	626	76.0	675	76.0	724	76.0
578	77.0	627	77.0	676	77.0	725	77.0
579	78.0	628	78.0	677	78.0	726	78.0
580	79.0	629	79.0	678	79.0	727	79.0
581	80.0	630	80.0	679	80.0	728	80.0
582	81.0	631	81.0	680	81.0	729	81.0
583	82.0	632	82.0	681	82.0	730	82.0
584	83.0	633	83.0	682	83.0	731	83.0
585	84.0	634	84.0	683	84.0	732	84.0
586	85.0	635	85.0	684	85.0	733	85.0
587	86.0	636	86.0	685	86.0	734	86.0
588	87.0	637	87.0	686	87.0	735	87.0
589	88.0	638	88.0	687	88.0	736	88.0
590	89.0	639	89.0	688	89.0	737	89.0
591	90.0	640	90.0	689	90.0	738	90.0
592	91.0	641	91.0	690	91.0	739	91.0
593	92.0	642	92.0	691	92.0	740	92.0
594	93.0	643	93.0	692	93.0	741	93.0
595	94.0	644	94.0	693	94.0	742	94.0
596	95.0	645	95.0	694	95.0	743	95.0
597	96.0	646	96.0	695	96.0	744	96.0
598	97.0	647	97.0	696	97.0	745	97.0
599	98.0	648	98.0	697	98.0	746	98.0
600	99.0	649	99.0	698	99.0	747	99.0
601	100.0	650	100.0	699	100.0	748	100.0



Table XIX

TAPE CONTACT DISTANCES (mm) FOR TAPE No. 18

No.	DISTANCE	No.	DISTANCE	No.	DISTANCE	No.	DISTANCE
1	5.3	26	2.6	51	10.1	76	8.2
2	5.0	27	5.7	52	13.9	77	8.0
3	2.2	28	4.3	53	9.0	78	5.3
4	4.9	29	2.0	54	8.8	79	2.4
5	3.2	30	1.6	55	10.8	80	1.5
6	3.5	31	2.0	56	2.3	81	17.0
7	14.3	32	8.6	57	7.0	82	5.2
8	21.1	33	6.6	58	7.1	83	14.0
9	37.2	34	6.3	59	4.0	84	9.2
10	7.4	35	8.0	60	3.3	85	3.3
11	7.4	36	2.2	61	2.3	86	13.6
12	4.1	37	3.6	62	4.9	87	119.9
13	24.0	38	23.0	63	3.7	88	81.0
14	56.6	39	.9	64	12.5	89	9.8
15	6.0	40	8.9	65	2.4	90	24.7
16	4.5	41	.9	66	2.0	91	49.4
17	5.3	42	13.0	67	4.5	92	8.9
18	13.1	43	9.4	68	8.0	93	2.3
19	3.0	44	6.2	69	11.0	94	2.4
20	16.9	45	5.4	70	13.5	95	5.6
21	9.0	46	14.4	71	5.9	96	3.3
22	10.0	47	3.2	72	2.3	97	3.7
23	60.3	48	1.3	73	8.2	98	9.0
24	2.2	49	7.8	74	6.7	99	28.5
25	5.6	50	2.1	75	12.3	100	4.6



## TABLE 1

TABLE 1. SUMMARY OF DATA FOR THE 1970-1971 SEASON

NO.	STATION	NO.	STATION	NO.	STATION	NO.	STATION
1	2.2	21	10.1	41	18.1	61	26.1
2	3.0	22	10.2	42	18.2	62	26.2
3	3.5	23	10.3	43	18.3	63	26.3
4	4.0	24	10.4	44	18.4	64	26.4
5	4.5	25	10.5	45	18.5	65	26.5
6	5.0	26	10.6	46	18.6	66	26.6
7	5.5	27	10.7	47	18.7	67	26.7
8	6.0	28	10.8	48	18.8	68	26.8
9	6.5	29	10.9	49	18.9	69	26.9
10	7.0	30	11.0	50	19.0	70	27.0
11	7.5	31	11.1	51	19.1	71	27.1
12	8.0	32	11.2	52	19.2	72	27.2
13	8.5	33	11.3	53	19.3	73	27.3
14	9.0	34	11.4	54	19.4	74	27.4
15	9.5	35	11.5	55	19.5	75	27.5
16	10.0	36	11.6	56	19.6	76	27.6
17	10.5	37	11.7	57	19.7	77	27.7
18	11.0	38	11.8	58	19.8	78	27.8
19	11.5	39	11.9	59	19.9	79	27.9
20	12.0	40	12.0	60	20.0	80	28.0
21	12.5	41	12.1	61	20.1	81	28.1
22	13.0	42	12.2	62	20.2	82	28.2
23	13.5	43	12.3	63	20.3	83	28.3
24	14.0	44	12.4	64	20.4	84	28.4
25	14.5	45	12.5	65	20.5	85	28.5
26	15.0	46	12.6	66	20.6	86	28.6
27	15.5	47	12.7	67	20.7	87	28.7
28	16.0	48	12.8	68	20.8	88	28.8
29	16.5	49	12.9	69	20.9	89	28.9
30	17.0	50	13.0	70	21.0	90	29.0
31	17.5	51	13.1	71	21.1	91	29.1
32	18.0	52	13.2	72	21.2	92	29.2
33	18.5	53	13.3	73	21.3	93	29.3
34	19.0	54	13.4	74	21.4	94	29.4
35	19.5	55	13.5	75	21.5	95	29.5
36	20.0	56	13.6	76	21.6	96	29.6
37	20.5	57	13.7	77	21.7	97	29.7
38	21.0	58	13.8	78	21.8	98	29.8
39	21.5	59	13.9	79	21.9	99	29.9
40	22.0	60	14.0	80	22.0	100	30.0

Table XIX

TAPE CONTACT DISTANCES (mm) FOR TAPE No. 16

No.	DISTANCE	No.	DISTANCE	No.	DISTANCE	No.	DISTANCE
101	2.0	126	14.0	151	1.7	176	9.0
102	7.5	127	3.3	152	4.4	177	9.0
103	5.5	128	9.0	153	7.3	178	4.0
104	5.9	129	7.3	154	1.8	179	42.7
105	4.5	130	8.6	155	9.7	180	7.6
106	9.6	131	6.3	156	5.4	181	3.0
107	6.0	132	20.0	157	4.1	182	2.2
108	19.0	133	26.0	158	22.8	183	15.7
109	20.9	134	3.0	159	2.6	184	22.9
110	4.0	135	7.4	160	7.2	185	2.5
111	3.2	136	8.7	161	7.2	186	2.5
112	2.3	137	5.5	162	19.4	187	199.0
113	3.8	138	1.2	163	21.1	188	10.6
114	7.4	139	7.0	164	4.0	189	8.8
115	5.2	140	6.4	165	21.4	190	5.8
116	8.3	141	2.2	166	24.0	191	2.0
117	3.5	142	3.8	167	30.7	192	38.2
118	17.7	143	15.5	168	7.7	193	9.8
119	7.1	144	4.0	169	2.6	194	21.2
120	16.0	145	5.4	170	12.9	195	17.3
121	7.6	146	8.0	171	22.9	196	5.7
122	21.1	147	7.4	172	9.0	197	3.0
123	7.0	148	12.0	173	17.9	198	14.4
124	2.3	149	6.0	174	22.4	199	6.2
125	4.0	150	2.0	175	24.2	200	4.2

Table 111

Table 111 (continued)

Row	Distance	Rate	Distance	Rate	Distance	Rate
101	5.0	1.52	10.0	1.52	15.0	1.52
102	5.0	1.52	10.0	1.52	15.0	1.52
103	5.0	1.52	10.0	1.52	15.0	1.52
104	5.0	1.52	10.0	1.52	15.0	1.52
105	5.0	1.52	10.0	1.52	15.0	1.52
106	5.0	1.52	10.0	1.52	15.0	1.52
107	5.0	1.52	10.0	1.52	15.0	1.52
108	5.0	1.52	10.0	1.52	15.0	1.52
109	5.0	1.52	10.0	1.52	15.0	1.52
110	5.0	1.52	10.0	1.52	15.0	1.52
111	5.0	1.52	10.0	1.52	15.0	1.52
112	5.0	1.52	10.0	1.52	15.0	1.52
113	5.0	1.52	10.0	1.52	15.0	1.52
114	5.0	1.52	10.0	1.52	15.0	1.52
115	5.0	1.52	10.0	1.52	15.0	1.52
116	5.0	1.52	10.0	1.52	15.0	1.52
117	5.0	1.52	10.0	1.52	15.0	1.52
118	5.0	1.52	10.0	1.52	15.0	1.52
119	5.0	1.52	10.0	1.52	15.0	1.52
120	5.0	1.52	10.0	1.52	15.0	1.52
121	5.0	1.52	10.0	1.52	15.0	1.52
122	5.0	1.52	10.0	1.52	15.0	1.52
123	5.0	1.52	10.0	1.52	15.0	1.52
124	5.0	1.52	10.0	1.52	15.0	1.52
125	5.0	1.52	10.0	1.52	15.0	1.52
126	5.0	1.52	10.0	1.52	15.0	1.52
127	5.0	1.52	10.0	1.52	15.0	1.52
128	5.0	1.52	10.0	1.52	15.0	1.52
129	5.0	1.52	10.0	1.52	15.0	1.52
130	5.0	1.52	10.0	1.52	15.0	1.52
131	5.0	1.52	10.0	1.52	15.0	1.52
132	5.0	1.52	10.0	1.52	15.0	1.52
133	5.0	1.52	10.0	1.52	15.0	1.52
134	5.0	1.52	10.0	1.52	15.0	1.52
135	5.0	1.52	10.0	1.52	15.0	1.52
136	5.0	1.52	10.0	1.52	15.0	1.52
137	5.0	1.52	10.0	1.52	15.0	1.52
138	5.0	1.52	10.0	1.52	15.0	1.52
139	5.0	1.52	10.0	1.52	15.0	1.52
140	5.0	1.52	10.0	1.52	15.0	1.52



Table XIX

## TAPE CONTACT DISTANCES (mm) FOR TAPE No. 18

No.	DISTANCE	No.	DISTANCE	No.	DISTANCE	No.	DISTANCE
201	5.4	219	3.2	236	6.0	253	9.0
202	4.1	220	5.0	237	40.5	254	40.6
203	2.1	221	14.1	238	3.8	255	23.0
204	2.6	222	4.2	239	4.0	256	15.7
205	19.0	223	1.0	240	10.0	257	7.5
206	12.5	224	2.6	241	4.0	258	2.2
207	6.0	225	3.8	242	17.5	259	4.4
208	2.0	226	1.9	243	3.9	260	10.4
209	2.2	227	26.0	244	13.7	261	2.5
210	2.5	228	98.0	245	4.0	262	2.5
211	6.0	229	5.6	246	14.8	263	21.0
212	1.8	230	9.2	247	4.7	264	7.0
213	3.9	231	6.9	248	1.0	265	3.7
214	3.7	232	7.3	249	4.0	266	5.5
215	4.4	233	2.6	250	3.2	267	2.4
216	2.3	234	2.0	251	34.3	268	6.0
217	1.7	235	2.3	252	69.3	269	3.4
218	10.8						



211

21.00 2000 1000 500 0 0 1000 2000 3000 4000 5000 6000 7000 8000 9000 10000

[illegible]

# APPENDIX E

## Tabulated Distribution of Contact Areas

	Page
Table XX. Table of Contact Area Distribution for All Tapes .....	54
Table XXI. Table of Contact Area Distribution for Tape 8 .....	55

# TABLE I

TABLE I. Results of the investigation of the effect of the concentration of the solution on the rate of the reaction.

Concentration of the solution, g/l.	Time, min.	Rate of the reaction, g/l. min.	Concentration of the solution, g/l.	Time, min.	Rate of the reaction, g/l. min.
0.1	10	0.01	0.2	10	0.02
0.2	10	0.02	0.3	10	0.03
0.3	10	0.03	0.4	10	0.04
0.4	10	0.04	0.5	10	0.05
0.5	10	0.05	0.6	10	0.06
0.6	10	0.06	0.7	10	0.07
0.7	10	0.07	0.8	10	0.08
0.8	10	0.08	0.9	10	0.09
0.9	10	0.09	1.0	10	0.10
1.0	10	0.10	1.1	10	0.11
1.1	10	0.11	1.2	10	0.12
1.2	10	0.12	1.3	10	0.13
1.3	10	0.13	1.4	10	0.14
1.4	10	0.14	1.5	10	0.15
1.5	10	0.15	1.6	10	0.16
1.6	10	0.16	1.7	10	0.17
1.7	10	0.17	1.8	10	0.18
1.8	10	0.18	1.9	10	0.19
1.9	10	0.19	2.0	10	0.20
2.0	10	0.20	2.1	10	0.21
2.1	10	0.21	2.2	10	0.22
2.2	10	0.22	2.3	10	0.23
2.3	10	0.23	2.4	10	0.24
2.4	10	0.24	2.5	10	0.25
2.5	10	0.25	2.6	10	0.26
2.6	10	0.26	2.7	10	0.27
2.7	10	0.27	2.8	10	0.28
2.8	10	0.28	2.9	10	0.29
2.9	10	0.29	3.0	10	0.30
3.0	10	0.30	3.1	10	0.31
3.1	10	0.31	3.2	10	0.32
3.2	10	0.32	3.3	10	0.33
3.3	10	0.33	3.4	10	0.34
3.4	10	0.34	3.5	10	0.35
3.5	10	0.35	3.6	10	0.36
3.6	10	0.36	3.7	10	0.37
3.7	10	0.37	3.8	10	0.38
3.8	10	0.38	3.9	10	0.39
3.9	10	0.39	4.0	10	0.40
4.0	10	0.40	4.1	10	0.41
4.1	10	0.41	4.2	10	0.42
4.2	10	0.42	4.3	10	0.43
4.3	10	0.43	4.4	10	0.44
4.4	10	0.44	4.5	10	0.45
4.5	10	0.45	4.6	10	0.46
4.6	10	0.46	4.7	10	0.47
4.7	10	0.47	4.8	10	0.48
4.8	10	0.48	4.9	10	0.49
4.9	10	0.49	5.0	10	0.50

Table XX

## TABLE OF CONTACT AREA DISTRIBUTION FOR ALL TAPES

Contact Area ( $\text{cm}^2 \times 10^5$ )	Mean Area ( $\text{cm}^2 \times 10^5$ )	No. of Contacts	Contact Area ( $\text{cm}^2 \times 10^5$ )	Mean Area ( $\text{cm}^2 \times 10^5$ )	No. of Contacts
0			146.0		
14.6	7.3	2524	160.6	153.3	4
29.2	21.9	155	175.2	167.9	3
43.8	36.5	69	189.8	182.5	3
58.4	51.1	39	204.4	197.1	4
73.0	65.7	29	219.0	211.7	5
87.6	80.3	7	233.6	226.3	3
102.2	94.9	10	248.2	240.9	3
116.8	109.5	12	262.8	255.5	2
131.4	124.1	8		270.1	2
	138.7	8		284.7	3

DISTRIBUTION OF CONTACT AREAS LESS THAN  $14.6 \times 10^{-5} \text{cm}^2$ 

Contact Area ( $\text{cm}^2 \times 10^5$ )	Mean Area ( $\text{cm}^2 \times 10^5$ )	No. of Contacts	Contact Area ( $\text{cm}^2 \times 10^5$ )	Mean Area ( $\text{cm}^2 \times 10^5$ )	No. of Contacts
0			7.30		
1.46	.73	1558	8.76	8.03	50
2.92	2.19	417	10.22	9.49	48
4.38	3.65	178	11.68	10.95	30
5.84	5.11	100	13.14	12.41	19
7.30	6.55	90	14.60	13.87	30



## Table 13

TABLE OF CONTACT AREA DISTRIBUTION FOR ALL TANKS

CONTACT AREA (cm <sup>2</sup> )	NO. OF CONTACTS	CONTACT AREA (cm <sup>2</sup> )	NO. OF CONTACTS	CONTACT AREA (cm <sup>2</sup> )	NO. OF CONTACTS
0	1	100.0	1	100.0	1
10.0	1	100.0	1	100.0	1
20.0	1	100.0	1	100.0	1
30.0	1	100.0	1	100.0	1
40.0	1	100.0	1	100.0	1
50.0	1	100.0	1	100.0	1
60.0	1	100.0	1	100.0	1
70.0	1	100.0	1	100.0	1
80.0	1	100.0	1	100.0	1
90.0	1	100.0	1	100.0	1
100.0	1	100.0	1	100.0	1
110.0	1	100.0	1	100.0	1
120.0	1	100.0	1	100.0	1
130.0	1	100.0	1	100.0	1
140.0	1	100.0	1	100.0	1
150.0	1	100.0	1	100.0	1
160.0	1	100.0	1	100.0	1
170.0	1	100.0	1	100.0	1
180.0	1	100.0	1	100.0	1
190.0	1	100.0	1	100.0	1
200.0	1	100.0	1	100.0	1

DISTRIBUTION OF CONTACT AREA FOR ALL TANKS

CONTACT AREA (cm <sup>2</sup> )	NO. OF CONTACTS	CONTACT AREA (cm <sup>2</sup> )	NO. OF CONTACTS	CONTACT AREA (cm <sup>2</sup> )	NO. OF CONTACTS
0	1	100.0	1	100.0	1
10.0	1	100.0	1	100.0	1
20.0	1	100.0	1	100.0	1
30.0	1	100.0	1	100.0	1
40.0	1	100.0	1	100.0	1
50.0	1	100.0	1	100.0	1
60.0	1	100.0	1	100.0	1
70.0	1	100.0	1	100.0	1
80.0	1	100.0	1	100.0	1
90.0	1	100.0	1	100.0	1
100.0	1	100.0	1	100.0	1
110.0	1	100.0	1	100.0	1
120.0	1	100.0	1	100.0	1
130.0	1	100.0	1	100.0	1
140.0	1	100.0	1	100.0	1
150.0	1	100.0	1	100.0	1
160.0	1	100.0	1	100.0	1
170.0	1	100.0	1	100.0	1
180.0	1	100.0	1	100.0	1
190.0	1	100.0	1	100.0	1
200.0	1	100.0	1	100.0	1

Table XXI

## CALCULATIONS TO OBTAIN DIAMETER OF AVERAGE CONTACT

## AREA FOR TAPE NO. 8

D	N	$(D/2)^2$	$(D/2)^2 N$	D	N	$(D/2)^2$	$(D/2)^2 N$
0	258	12.5		0	148	1.3	192
10.0				3.2	30	3.8	114
14.1	27	37.5	101	4.5	24	6.3	151
17.3	20	62.5	125	5.5	22	8.8	193
20.0	7	87.5	612	6.3	15	11.3	170
22.4	6	112.5	675	7.1	8	13.8	110
24.5	3	137.5	413	7.7	8	16.3	130
26.4	3	162.5	488	8.4	1	18.8	19
28.3	4	187.5	751	8.9	1	21.3	21
30.0	4	212.5	848	9.5	1	23.8	24
31.6	3	237.5	712	10.0			
33.2	1	262.5	263		<u>258</u>		<u>1124</u>
34.6	1	287.5	287				
36.0	0	312.5	0				
37.4	1	337.5	338	46.9	1	550	550
38.7	2	362.5	725	47.8	1	572	572
40.0	2	387.5	775	55.2	1	762	762
41.2	1	412.5	412	60.0	1	900	900
42.4	2	437.5	875	72.2	1	1320	1320
43.6	1	462.5	462	81.4	1	1660	1660
44.7	1	487.5	488		<u>6</u>		<u>5764</u>
	<u>347</u>		<u>9350</u>				

# TABLE 1

RELATIONSHIP BETWEEN THE NUMBER OF INSTRUCTIONS

AND THE TIME TAKEN

$S(N)$	$S(N)$	$N$	$N$	$S(N)$	$S(N)$	$N$	$N$
100	1.1	100	1.1	100	1.1	100	1.1
110	1.2	110	1.2	110	1.2	110	1.2
120	1.3	120	1.3	120	1.3	120	1.3
130	1.4	130	1.4	130	1.4	130	1.4
140	1.5	140	1.5	140	1.5	140	1.5
150	1.6	150	1.6	150	1.6	150	1.6
160	1.7	160	1.7	160	1.7	160	1.7
170	1.8	170	1.8	170	1.8	170	1.8
180	1.9	180	1.9	180	1.9	180	1.9
190	2.0	190	2.0	190	2.0	190	2.0
200	2.1	200	2.1	200	2.1	200	2.1
210	2.2	210	2.2	210	2.2	210	2.2
220	2.3	220	2.3	220	2.3	220	2.3
230	2.4	230	2.4	230	2.4	230	2.4
240	2.5	240	2.5	240	2.5	240	2.5
250	2.6	250	2.6	250	2.6	250	2.6
260	2.7	260	2.7	260	2.7	260	2.7
270	2.8	270	2.8	270	2.8	270	2.8
280	2.9	280	2.9	280	2.9	280	2.9
290	3.0	290	3.0	290	3.0	290	3.0
300	3.1	300	3.1	300	3.1	300	3.1
310	3.2	310	3.2	310	3.2	310	3.2
320	3.3	320	3.3	320	3.3	320	3.3
330	3.4	330	3.4	330	3.4	330	3.4
340	3.5	340	3.5	340	3.5	340	3.5
350	3.6	350	3.6	350	3.6	350	3.6
360	3.7	360	3.7	360	3.7	360	3.7
370	3.8	370	3.8	370	3.8	370	3.8
380	3.9	380	3.9	380	3.9	380	3.9
390	4.0	390	4.0	390	4.0	390	4.0
400	4.1	400	4.1	400	4.1	400	4.1
410	4.2	410	4.2	410	4.2	410	4.2
420	4.3	420	4.3	420	4.3	420	4.3
430	4.4	430	4.4	430	4.4	430	4.4
440	4.5	440	4.5	440	4.5	440	4.5
450	4.6	450	4.6	450	4.6	450	4.6
460	4.7	460	4.7	460	4.7	460	4.7
470	4.8	470	4.8	470	4.8	470	4.8
480	4.9	480	4.9	480	4.9	480	4.9
490	5.0	490	5.0	490	5.0	490	5.0
500	5.1	500	5.1	500	5.1	500	5.1
510	5.2	510	5.2	510	5.2	510	5.2
520	5.3	520	5.3	520	5.3	520	5.3
530	5.4	530	5.4	530	5.4	530	5.4
540	5.5	540	5.5	540	5.5	540	5.5
550	5.6	550	5.6	550	5.6	550	5.6
560	5.7	560	5.7	560	5.7	560	5.7
570	5.8	570	5.8	570	5.8	570	5.8
580	5.9	580	5.9	580	5.9	580	5.9
590	6.0	590	6.0	590	6.0	590	6.0
600	6.1	600	6.1	600	6.1	600	6.1
610	6.2	610	6.2	610	6.2	610	6.2
620	6.3	620	6.3	620	6.3	620	6.3
630	6.4	630	6.4	630	6.4	630	6.4
640	6.5	640	6.5	640	6.5	640	6.5
650	6.6	650	6.6	650	6.6	650	6.6
660	6.7	660	6.7	660	6.7	660	6.7
670	6.8	670	6.8	670	6.8	670	6.8
680	6.9	680	6.9	680	6.9	680	6.9
690	7.0	690	7.0	690	7.0	690	7.0
700	7.1	700	7.1	700	7.1	700	7.1
710	7.2	710	7.2	710	7.2	710	7.2
720	7.3	720	7.3	720	7.3	720	7.3
730	7.4	730	7.4	730	7.4	730	7.4
740	7.5	740	7.5	740	7.5	740	7.5
750	7.6	750	7.6	750	7.6	750	7.6
760	7.7	760	7.7	760	7.7	760	7.7
770	7.8	770	7.8	770	7.8	770	7.8
780	7.9	780	7.9	780	7.9	780	7.9
790	8.0	790	8.0	790	8.0	790	8.0
800	8.1	800	8.1	800	8.1	800	8.1
810	8.2	810	8.2	810	8.2	810	8.2
820	8.3	820	8.3	820	8.3	820	8.3
830	8.4	830	8.4	830	8.4	830	8.4
840	8.5	840	8.5	840	8.5	840	8.5
850	8.6	850	8.6	850	8.6	850	8.6
860	8.7	860	8.7	860	8.7	860	8.7
870	8.8	870	8.8	870	8.8	870	8.8
880	8.9	880	8.9	880	8.9	880	8.9
890	9.0	890	9.0	890	9.0	890	9.0
900	9.1	900	9.1	900	9.1	900	9.1
910	9.2	910	9.2	910	9.2	910	9.2
920	9.3	920	9.3	920	9.3	920	9.3
930	9.4	930	9.4	930	9.4	930	9.4
940	9.5	940	9.5	940	9.5	940	9.5
950	9.6	950	9.6	950	9.6	950	9.6
960	9.7	960	9.7	960	9.7	960	9.7
970	9.8	970	9.8	970	9.8	970	9.8
980	9.9	980	9.9	980	9.9	980	9.9
990	10.0	990	10.0	990	10.0	990	10.0
1000	10.1	1000	10.1	1000	10.1	1000	10.1

## APPENDIX F

## Sample Calculations

	Page
I. Average Diameter of Contacts for Tape 8 .....	A 57
II. Diameter of Average Contact Area for Tape 8 .....	A 58



1. Bureau Director of Statistics for Page 1, A. 17

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.....

## SAMPLE CALCULATIONS

Average diameter of the contact  
areas for Tape 8

The data for Tape 8 is given in Tables 1 and 9.

$\Sigma N$  = total number of contacts = 353

$\Sigma d$  = sum of all contact tape distances = 3,060.5mm

$\bar{d}$  = average contact tape distance

$\bar{d} = \Sigma N / \Sigma d = 3,060.5 / 353 = 8.675\text{mm}$

Tape speed = 100mm/sec.

Crossing speed =  $r\Omega$

where:  $r$  = distance from center of rotation of the  
slider to the probe contact wire in mm.

$\Omega$  = angular velocity of the slider in  
radians/sec.

Crossing speed =  $(1.2 \times 25.4) (24/441) (\pi/60) = .0868\text{mm/sec.}$

$d_d$  = average diameter of the contact areas

$d_d = \frac{\bar{d} \times (\text{crossing speed})}{2 \times (\text{tape speed})} = \frac{8.675(.0868)}{2 \times (100)} = 3.77 \times 10^{-4}\text{cm.}$

## ANALYSIS

average diameter of the conduct

area for zone A

The data for zone B is given in Tables I and II.

$\Sigma N$  = total number of conductors = 397

$\Sigma A$  = sum of all conduct area sections = 3,000,000

$\bar{A}$  = average conduct area distance

$\Sigma = \Sigma \sqrt{A} = 1,000,000 = 1.0 \times 10^6$

Zone speed = 1000/sec.

Grossing speed = 1.0

$r$  = distance from center of rotation of the

axis to the point conduct area in m.

$\Omega$  = angular velocity of the axis in

rad/sec.

Grossing speed =  $(1.0 \times 10^6) / (1.0 \times 10^6) = 1.0$

$\Delta$  = average diameter of the conduct area

$\Delta = \frac{\Sigma \sqrt{A}}{\Sigma N} = \frac{1,000,000}{397} = 2.52 \times 10^3$

## SAMPLE CALCULATIONS

Diameter of the average contact area for Tape 8

The statistical analysis of the data for Tape 8 is given in Table XX.

$N$  = number of contacts in one interval

$D$  = the square root of the average of the squares of the two extreme tape distances for one interval

$\bar{D}$  = the square root of the average of the squares of all the tape distances

$$\bar{D}^2 = \sum (ND^2) / \sum N$$

$$\bar{D}/2 = \sqrt{\sum [N(D/2)^2] / \sum N} = \sqrt{16238/353} = 6.80\text{mm}$$

$d_A$  = diameter of the average contact area

$$d_A = \frac{\bar{D} \times (\text{crossing speed})}{2 \times (\text{tape speed})} = \frac{6.80(.8867)}{100} = 5.90 \times 10^{-4} \text{cm}$$



# Statistical Analysis

Diagram of the average contact level for type B

The statistical analysis of the data for type B

is given in Table II.

A number of contacts in one interval  
 = the square root of the average of the squares of the  
 two extreme line distances for one interval  
 = the square root of the average of the squares of all  
 the line distances

$$S_y = \sqrt{\sum y^2 / N}$$

$$S_x = \sqrt{\sum x^2 / N} = \sqrt{10238.72 / 20} = 22.5$$

$S_d$  = standard deviation of the error of contact level

$$S_d = \sqrt{\frac{\sum (y - \bar{y})^2}{N-1}} = \sqrt{\frac{10238.72 - 20 \times 22.5^2}{19}} = 2.00 \times 10^{-2}$$

of a contact level with respect to the average

$$S_d = \sqrt{\frac{\sum (x - \bar{x})^2}{N-1}} = \sqrt{\frac{10238.72 - 20 \times 22.5^2}{19}} = 2.00 \times 10^{-2}$$

## APPENDIX G

## BIBLIOGRAPHY

1. Holm, R., "Electric Contacts", H. Werbers, Stockholm (1946)
2. Rabinowicz, E., "The Nature of Static and Kinetic Coefficients of Friction", Journal of Applied Physics, Vol. 22, No. 11, pp 1373-1379 (Nov. 1951)
3. Rabinowicz, E., and Tabor, D., "Metallic Transfer Between Sliding Metals and Autoradiographic Studies", Proceedings of the Royal Society (London) Series A, Vol. 205, pp. 455-475 (1951)
4. Dyson, J., and Hirst, W., "The True Contact Area Between Solids", Proceedings of the Physical Society Sect. B, Vol. 67, pp. 309-312 (1954)
5. Feng, I-Ming, "Metal Transfer and Wear", Journal of Applied Physics, Vol. 23, No. 9, pp. 1010-1019, (Sept. 1952)
6. Rabinowicz, E., "Auto-Correlation Analysis of the Sliding Process", Journal of Applied Physics, Vol. 27, No. 2, pp. 131-135 (Feb. 1956)
7. Kerridge, W., "Metal Transfer and the Wear Process", Proceedings of the Physical Society, Sect. B, Vol. 68, pp. 400-407 (1955)
8. Feng, I-Ming, "Applications of Polystyrene Particles in Conjunction with Shadow Casting to the Study of Polished Metallic Surfaces", Journal of Applied Physics, Vol. 22, No. 6, pp. 820-824 (June 1951)
9. Bowden, F.P., and Tabor, D., "The Friction and Lubrication of Solids", Oxford Press (1950)

# APPENDIX B

## BIBLIOGRAPHY

1. HOLT, H. "Electricity and the future of the world," *Scientific American*, (1966)
2. LAMBERT, J. "The future of electric and electronic systems," *Journal of Applied Electronics*, Vol. 12, No. 12, pp. 1217-1222 (Nov. 1961)
3. KASPEROVICH, G. and TAYLOR, D. "Specialized Transistors," *Transistors and the future of the world*, (London) Series A, Vol. 100, pp. 122-123 (1961)
4. DYSON, J. and HILL, J. "The future of the world," *Scientific American*, (1966)
5. LAMBERT, J. "The future of the world," *Scientific American*, (1966)
6. LAMBERT, J. "The future of the world," *Scientific American*, (1966)
7. LAMBERT, J. "The future of the world," *Scientific American*, (1966)
8. LAMBERT, J. "The future of the world," *Scientific American*, (1966)
9. LAMBERT, J. "The future of the world," *Scientific American*, (1966)
10. LAMBERT, J. "The future of the world," *Scientific American*, (1966)











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